Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA.

VOL. XXXVI. No. 2. NEW YORK, WEDNESDAY, JANUARY 10, 1900. ISSUED WEEKLY.

Electrical Review

TIMES BUILDING, 41 PARK ROW,
P. O. BOX 2339. NEW YORK.

CHARLES W. PRICE, - - - - - - - - EDITOR.
STEPHEN L COLES, - - - - MANAGING EDITOR.
CHARLES T. CHILD, - - - - TECHNICAL EDITOR.
STEPHEN H GODDARD, - - ADVERTISING MANAGER.
RUSSELL HOWLAND, ASS'T ADVERTISING MANAGER.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," - - - - NEW YORK.
TELEPHONE CALL, 1546 "CORTLANDT."

WESTERN OFFICE:
FRANK E. COLBERT, - REPRESENTATIVE,
955 Old Colony Building, Chicago.

WASHINGTON OFFICE:
GEO. C. MAYNARD, - - REPRESENTATIVE,
Room 102, Washington Loan and Trust Building,
WASHINGTON, D C.

LONDON OFFICE:
HENRY W. HALL, - - REPRESENTATIVE,
42 Old Broad Street, LONDON, E C.
News, Subscriptions and Advertisements.

Subscription to the
ELECTRICAL REVIEW.

One Year, United States and Canada, - - $3.00
One Year, Foreign Countries, - - - - - - - - 5.00
Single Copies, each - - - - - - - - - - 10
Copies can be supplied for only one year back, at 25 cents each.

CONTENTS:

	PAGE
Electrical Patents	27
The Transpacific Cable	33
Lamp Efficiency	33
"The Useless Commutator"	34
An American Pacific Cable	35
Mr. S. Dana Greene Drowned	37
A New Method for Studying Hysteresis Curves in Samples of Iron and Steel	38
Export Notes	39
A Group of Prominent Telephone Officials	39
Electrolytic Production of Aluminum	40
Trade with Central Italy	40
Notes on Light	41
Electrical Men of the West	41
Tramways and the Housing of the Working Classes	42
Trolley Competition with Steam Railway	43
Science Brevities	44
Views, News and Interviews	45
A Correspondence School of Electricity	45
Present Electrical Tendencies	46
Telephone and Telegraph	48
A Rheostat Factory	49
Automobiles and Electric-Power Plants in Sweden	50
An Electrical Specialty Manufacturing Plant	51
Municipal Electric Light Plant Finance	51
Literature	51
Electricity Supply From Central Stations	52
Boston and Portsmouth, N. H., Connected by Trolley Lines	52
An Interesting Application of Niagara Power	53
Leadville, Colorado, Wants Electric Power	53
Election of Directors of the Brooklyn Electric Lighting Company	53
Wall Street and the Electrical Stock Market	53
Electric Railways	54
Our New Year Double Number	54
Important Electric Lighting Changes in Kansas City	54
Electric Lighting	54
Industrial Notes	55
Holiday Souvenirs	55
Advance Information	56

Advertisers' Index, page 16.

THE TRANSPACIFIC CABLE.

In an exceedingly interesting paper read before the American Institute of Electrical Engineers, and reprinted in part on another page, Captain George O. Squier has presented an able *ex parte* argument for the immediate construction of a transpacific cable connecting the mainland of the United States with the Philippine Islands, China and Japan.

There can be no manner of doubt that such a cable is urgently necessary, and that it should be laid. From commercial, strategic and economical considerations it is demanded. Swifter and more easily than any other instrumentality it would work for the pacification and upbuilding of the Philippines and the cementing of our trade relations with eastern Asian peoples. It would complete the electric girdle of the earth and render interruption of communication with its various stations a practical impossibility, by virtue of the fact that it would give two directions of exit for signals from any point. Indeed, it may be called the most urgently demanded improvement in the world's system of communication.

But, even in view of the pressure of commercial and military necessity, it is by no means sure that such a cable will be laid at once. Captain Squier argues its entire feasibilty from a somewhat academic standpoint. It is certainly possible to lay stretches of cable from the Californian coast to the Hawaiian Islands, thence to Midway or Wake Island, to Guam and to the Philippines, no stretch being too long for easy working. The route has been surveyed in part, and no physical conditions supervene to prevent the accomplishment of the work—provided the cable can be had to lay.

This is the crucial point. A deep-sea cable of this character must be made with a gutta-percha insulation. Nothing else so far discovered in all the vast range of natural and artificial products will answer the purpose. At the least reasonable estimate the total amount of this gum required would be about 1,200 tons. Where is it to come from?

The only regions in the world in which the gutta-percha producing tree grows are the Malay Peninsula and certain small sections of Borneo and other islands of the East Indian archipelago. The forests have been culled by ignorant and careless processes until the trees are almost extinct, and it takes them thirty years to reach maturity. It is doubtful if there is as much as 100 tons of gutta-percha in the markets of the whole world to-day.

Until, therefore, there shall be a visible supply of the first essential of cable-making, the construction of a new cable over seven thousand miles long seems hardly practicable.

LAMP EFFICIENCY.

The hopes that were raised by the announcement of Dr. Nernst's discovery of a highly efficient electric lamp have grown somewhat cold. We still have the carbon filament incandescent lamp—far better than its prototypes—but still lacking in ability to convert efficiently the energy of the applied current into light. It merely gets hot and shines, and how much of its radiant output is heat and how much light depends on its method of making, the temperature at which it is worked, the condition of its surface, and other qualities too numerous to catalogue. Much of the effort of lamp makers is concentrated on securing an efficient product, and the effort is by no means wasted. When one considers the cycle of energy transformations between the burning coal under the boiler and the glowing filament he realizes the vital importance of high-efficiency lamps. Every transformation—from fire heat to expansive steam pressure, from pressure to motion of the engine, from engine power to dynamo current, from current to light—is attended with loss. It is as if the lamps were the pinnacle of a pyramid, the light the residual

essence of the burning coal. A saving in the lamp means a greater saving in power, a reduction of circuits, dynamo capacity, engine and boiler output and coal. And the biggest reduction is in the coal.

"THE USELESS COMMUTATOR."

In Professor Sylvanus Thompson's address before the Institution of Electrical Engineers, of which an abstract appears on another page, there is a reference to the seemingly unnecessary complexity of current supply systems in which alternating currents are generated, transformed in voltage, distributed, again transformed, converted into direct current and fed through commutators into the armatures of direct-current motors as alternating current again. Why, he asks, is the unnecessary commutator retained?

This is an interesting query, but it is certainly not possible in the present state of the art to cast the commutator upon the scrap-heap or melt up the precious copper of which it is built for other uses; not entirely so, at least. One, and a very important one, of the reasons is that alternating current will not produce a steady unidirectional field of magnetic force. Another is that the direct-current motor is docile and tractable and will start itself properly.

It is interesting to note the actions that take place in the armature of a street-car motor, for example, when it is started. The first surge of current in the machine starts two systems of lines of magnetic force streaming through the metals of the magnetic circuit. Under the effort of these two, one due to the field winding and one to the armature coils, to become coincident, the armature starts to turn. At that instant the current in any one wire of its winding becomes alternating, its periodicity going up the scale as the armature gathers speed. But as the rotation is necessarily precisely synchronous with the alternations due to it, the waves stand still in space with relation to the field of the motor. Now, if alternating current of variable and increasing periodicity could be supplied to the armature, and the steady field due to the pole-pieces at the same time maintained, it could start in step with the current and move up to its maximum velocity without requiring a commutator. But no way of making the alternating current of rising periodicity has yet been devised that is so good as the despised commutator.

In a recent consular report it was stated that a good deal of trouble has been caused in Russia owing to the advance of wheat to 23 kopecks per pood. This statement is doubtless full of interest; the difficulty is to know what it means. It is precisely the same difficulty, however, that a Russian would have felt if the price had been quoted to him in cents per pound. This illustration is mentioned for the benefit of those manufacturers who are seeking export trade with catalogues made up using American weights, measures and prices. It is so easy and so cheap to have circular matter translated and printed, not only in the language, but with reference to the wants and understandings of the people to whom it is addressed, that it is strange so little of it has been done. A great German machine manufacturing establishment sent to China three years ago two bright young engineers of its employ for the sole purpose of learning the language. One of them has now returned to the home office. The consequence is that this firm has a representative on the ground, speaking the language and knowing the wants of the people, and a similarly equipped employé in its own office, so that the export business to China is handled with a facility and dispatch utterly impossible in any other way. It is certain that if any Russian establishment came over here and quoted us goods at so many kopecks per pood it would have difficulty in selling them. We should not forget that we do precisely the same thing when we go to Japan or Germany, for example, and quote our materials in dollars per ton or cents per foot.

Since the introduction of steam upon railways seventy years ago, there has been only one invention of really epoch-marking importance having to do with the operation of trains. This one ranks second to the locomotive itself, because through its agency high speeds became possible, because it gave a measure of control to trains never possible before its application, and because it added enormously to the safety of operation of railroads. It is, of course, the power brake.

Now the evolution of the electric street railway is comparable to that of the steam railroad in many ways, the principal difference being that it is swifter. Already the early electric cars of Daft and Vandepoele and Sprague look as antiquated to our eyes as do the John Bull, the Puffing Billy, the Rocket and other famous locomotives of the early thirties. But, while the cars have waxed great in size and the motors grown in speed, the contrivances for stopping them are still the same as in those distant days when two meek horses drew each car to an accompaniment of jingling bells. Suppose the Congressional Limited train had a husky brakeman on each platform ready to turn a hand-wheel for dear life when the whistle blew "down brakes;" could it dare run at sixty miles an hour? And is this any more ridiculous an idea than that of big trolley cars going at headlong speeds with only a hand-brake to stop them?

Few who look upon the spectacle of a great city illuminated by electricity realize the tremendous total of power required to keep the lights burning. In Greater New York the energy consumed amounts to an amazing total; it would lift a 100-ton locomotive at a rate but little less than the speed of a modern cannon-ball, or hoist the great steamship Oceanic with all its freights aboard faster than any elevator in the city is worked.

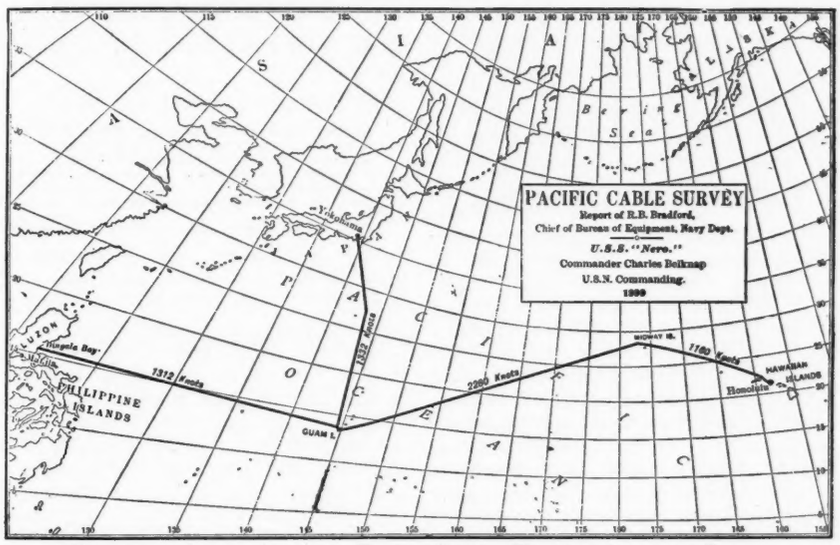
The gasoline automobile is in a hard position. It appears that the fire insurance companies and the Board of Combustibles, in New York city, are both determined that gasoline shall not be kept in large quantities anywhere in the city. A company, desiring to establish a repository for automobiles, was driven from pillar to post in the search for premises on which it could store liquid fuel for explosion motor vehicles, but without success.

From every side comes commendation of the ELECTRICAL REVIEW'S New Year number and the changes it inaugurated. To the James Kempster Printing Company and the Jessup & Moore Paper Company no small part of the credit for the fine appearance of this issue is due.

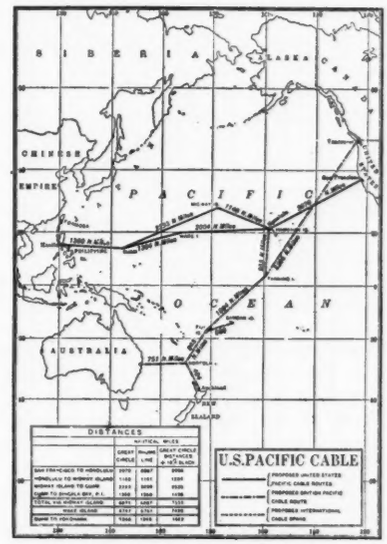
AN AMERICAN PACIFIC CABLE.*

BY CAPTAIN GEORGE OWEN SQUIER, U.S.A.

It is interesting to note that the idea of a trans-Pacific submarine cable was first discussed and considered by the late Cyrus W. Field, nearly thirty years ago. The scheme of Mr. Field and his associates involved a route from California *via* Alaska and the Aleutian Islands to Japan. Since that date, the subject in some form has been almost constantly before this country and Great Britain. This question has been discussed in the fifty-second, fifty-fourth and fifty-fifth Congresses, in each of which effort was made looking towards laying a cable at least as far as the Hawaiian Islands.



FIGS. 1 AND 2.—AN AMERICAN PACIFIC CABLE. THE ALL-AMERICAN ROUTE.



OTHER PROPOSED ROUTES.

In a special message to Congress, dated February 10, 1899, the President says:

"As a consequence of the ratification of the treaty of peace between the United States and Spain, and its expected ratification by the Spanish Government, the United States will come into possession of the Philippine Islands, on the farther shore of the Pacific. The Hawaiian Islands and Guam becoming United States territory, and forming convenient stopping places on the way across the sea, the necessity for speedy cable communication between the United States and all these Pacific islands has become imperative. * * * At present the Philippines can be reached only by cables which pass through many foreign countries, and the Hawaiian Islands and Guam can only be communicated with by steamers, involving delays in each instance of at least a week. The present condition should not be allowed to continue for a moment longer than is absolutely necessary."

The idea of a British Pacific cable, connecting the Dominion of Canada with the Australasian colonies, almost from the first has been discussed from a national standpoint. Her Majesty's Government and the colonial governments most concerned, have been urged from time to time to consider the matter in its strategic and commercial aspects. At this moment a Pacific cable touching only soil belonging to Great Britain is assured, both Canada and Australasia recently having been reported as joining with England in pledging themselves to the enterprise as a government undertaking.

The proposed route with surface distances involved, is shown on the accompanying map, and is from Vancouver to Fanning Island, thence to the Fiji Islands, thence to Norfolk Island, and from there bifurcating to New Zealand and Queensland.

Since a Pacific cable will at last complete the telegraphic circuit of the globe, it will give the peculiar advantage of placing each point thereon in cable connection with every other point by *two* distinct routes either east or west.

The cardinal idea in the British system has been that all state cables shall touch only British soil, and this principle has placed British cable traffic in the Pacific forever at a disadvantage over the American cable for the reason that the only available route involves a single span of cable from Vancouver to Fanning Island, over 3,500 miles in length; whereas, by the annexation of the Hawaiian Islands, the United States, while following a similar principle, will have no span longer than the present Atlantic cables, or about 2,500 miles in length.

Since the speed of cabling decreases in general with the square of the length of the cable, and the speed of the whole system is limited by the speed of the slowest span, that system requiring the longest single span is ultimately at a disadvantage, provided the systems are in direct competition. In the projected Pacific cable enterprises, however, although, as will be pointed out later, they will operate in close relations with each other, yet each has a sufficient prospective traffic to guarantee the enterprise as a sound financial success from the beginning.

In the consideration which, from time to time, has been given the project of spanning the Pacific ocean by a submarine cable, the Northern route, *via* Alaska, the Aleutian Islands, Siberia, and Japan has been frequently proposed.

In recent years the British Government, in its proposed line from Canada to Australasia first projected this northern route owing to the absence, at that time, of information respecting the southern Pacific ocean, and the impression which prevailed that physical difficulties existed which offered insuperable obstacles to the laying of a cable on a direct route between Canada and Australasia. In consequence of this impression it was designed to lay the cable from Vancouver to Japan, touching at Islands in theAleutian and Kurile groups as mid-ocean stations. From Japan the connection with Australasia would have been obtained *via* Singapore and the Eastern Extension Company's lines of telegraph. Through the intervention of the government, negotiations were opened with the view of securing one of the Kurile Islands. Japan was asked to transfer to the British crown one of these islands in order that the telegraph station should be under British protection, and an agent was sent to Washington who, after some difficulty, obtained conditional landing privileges on one of the Aleutian Islands.

Recently there has been a revival of interest in this route, especially now that the growing commercial interests of

* Extracts from a paper read before the American Institute of Electrical Engineers.

Alaska are becoming important. The plan proposes starting from Cape Flattery, thence to Sitka, distances (approximate) 803 miles; thence to Kadiak Island, 682 miles; thence to Dutch Harbor, 770 miles; thence to Attu, 810 miles; thence to the Japan-Russian border, 858 miles; thence to the Japanese land lines, 810 miles; from the Siberian border to the Siberian lines, 617 miles; and from Formosa to Luzon, 200 miles; in all 5,550 nautical miles, exclusive of the Japanese system.

Apart from establishing telegraphic communication free from foreign control between the United States, the Hawaiian Islands, the Philippine Islands and the island of Guam, the mission of an American Pacific cable should be to bring about a general reduction of cable rates.

Undoubtedly an Alaskan cable will soon be required, and apparently also the extension of such a cable system as a means of attaining a through line to the Philippine Islands is an attractive plan. This plan, however, leaves the United States in practically the same unsatisfactory position she is in at present in respect to communication with her Pacific possessions, and until definate and perpetual concessions are forthcoming, can furnish even no guaranty of substantial reduction from the present high rates.

It is believed that no one studying the true present and future interests of the United States can come to any other conclusion relative to an American Pacific cable, than the one so admirably expressed by the President in his special message to Congress, *viz.* that this cable shall be "wholly under control of the United States."

This cardinal idea—the principal also adopted by Great Britain,after years of exhaustive consideration—at once excludes the northern route for the present, and limits the route to American territory.

There is no longer any doubt as to the practicability of the Pacific cable project from a technical and engineering point of view. A preliminary survey between the coast of California and the Hawaiian Islands was completed by the Navy department in 1892, showing the entire practicability of this part of the route. Between California and the Hawaiian Islands several approximately parallel routes are practicable, but the one which seems to be favored by the survey of 1892, as shown in the report of the Hydrographic office of the Bureau of Navigation, is a rhumb-line between Monterey Bay and Honolulu on Oahu Island. The U. S. S. Nero, under command of Commander Charles Belknap, U. S. N., has been engaged since April last in a survey of the bed of the Pacific along the proposed route of the cable from the Hawaiian Islands westward to the Philippine Islands and to Japan. A preliminary report of this survey recently received, adds greatly to the knowledge of this part of the Pacific and to the data necessary before determining the exact route of the cable. This survey develops two unusual physical features along the route *via* Midway Island. One of these is a submarine mountain, situated a short distance westward of the Midway Islands and rising from the floor of the ocean, having a depth of 2,200 fathoms, to within 82 fathoms of the surface. The second feature is one of the deepest submarine abysses yet found in the world, situated about 500 miles eastward of Guam and more than 4,900 fathoms in depth. These and other obstacles which may be found, however, can be avoided in laying the cable by making suitable detours around them as is ordinarily done.

The great decrease in speed and increase of cost consequent upon increase of length af a single span of the cable requires a landing station, if possible, between the Hawaiian Islands and Guam. The longest cable yet laid and in operation is the French cable from Brest, France, to Cape Cod, Mass., which is about 3,250 nautical miles in length, and there is no question that a cable directly connecting Honolulu and Guam could be successfully laid, if no practicable landing place between these points could be obtained. This single span, however, about 3,650 nautical miles, including "slack," would for all time so reduce the through speed of the cable, and so increase the original cost, as to warrant unusual expense, if necessary, in preparing and maintaining an intermediate station. In this connection the large amount of technical evidence given before the British Pacific Cable Committee relative to the Vancouver-Fanning Island span, which is practically the same extreme length of 3,600 nautical miles, and of the utilization of Fanning Island as a station, are valuable as showing entire practicability. Although both Wake and Midway Islands, which have been proposed as stations, are low atolls, rising but a few feet above high water and with little to sustain human life, yet either of these places is equal, if not superior, to Fanning Island. Further careful surveys will be necessary before the exact route west from the Hawaiian Islands to Guam can be finally determined. Fortunately for this enterprise, the annexation of the Hawaiian group brought under the sovereignty of the United States eleven or twelve small rocky or sandy islands extending to the northwestward about 1,800 miles from Honolulu. These must be surveyed and considered from the cable standpoint before a final selection of route can be made.

The distances in nautical miles along two provisional routes, including ten per cent for "slack" in laying, are as follows:

San Francisco to Honolulu	2,286 miles.
Honolulu to Midway Island	1,254 "
Midway Island to Guam	2,523 "
Guam to Dingala Bay, P. I.	1,496 "
Total *via* Midway Island	7,559 "
San Francisco to Honolulu	2,286 miles.
Honolulu to Wake Island	2,205 "
Wake Island to Guam	1,435 "
Guam to Dingala Bay, P. I.	1,495 "
Total *via* Wake Island	7,429 "

The cost of laying cable depends mainly upon the materials used in its construction, and therefore fluctuates with prices current. The outer coverings are much the same in all specifications, according to the conditions of the case, but the copper conductor and the gutta-percha insulation vary with the speed required over the cable. Since the length of the longest section of the proposed Pacific cable is approximately equal to each of several of the Atlantic cables, the type of the cable to be used for this section, and the speed obtainable are subject to a close estimation.

Of the eleven cables spanning the north Atlantic, the Anglo-American Company's cable laid in 1894, and the Commercial Cable Company's cable No 3 laid also in 1894, have the greatest speeds. The former contains 650 pounds of copper and 400 pounds of gutta-percha, and the latter 500 pounds copper and 320 pounds gutta-percha per nautical mile. Either of these types of cable would give good results and no cables of less equivalent speed should be considered.

The following conservative estimate is made from the evidence obtainable relative to the establishment of this enterprise by the government on a sound financial basis:

MAINTENANCE AND REPAIR PER ANNUM.

Annual expenses of two cable repair ships	$300,000
Annual expense for new cable, assuming entire cable to be replaced in 40 years, or 200 miles per year	200,000
Working expenses	125,000
Reserved fund, and interest on capital	400,000
Total net earnings of cable required	$925,000

This provision for laying 200 miles of new cable per year should perpetually maintain the value of the cable as an asset, and the reserve fund further provides that the entire capital shall be replaced at the end of fifty years, or what is equivalent, that a sinking fund shall be established, which, at the end of fifty years will be sufficient to lay an entire new cable in addition to the permanent maintenance of the original one, so that at the end of fifty years, two working cables will be provided for.

Taking average conditions for long cables ten years ago, the annual expenses for maintenance and repair, *e. g.*, for new cable required, etc., and not including the fixed expenses such as the repair ships, was about $30 per nautical mile. The great advancement in cable manufacture since has reduced the average repair rate materially, but assuming this rate as it then averaged, the total charge to this item is practically the same as that given by the independent supposition above.

At present there is no first-class cable ship in the world flying the American flag and which would therefore be under the control of the United States in time of war. It should be the policy of the United States, whether the Pacific cable is laid by the government or by a subsidized company, to require that two complete cable repair ships, one, at least, also capable of laying long cables, equal to any yet constructed for these purposes, and flying the American flag, be stationed in the Pacific ocean.

The "speed" of a cable is a somewhat loose expression and depends upon the voltage used, the particular apparatus employed in working the cable, as well as in the design and construction of the cable itself, and the skill of the operators. Besides, there is a considerable margin be-

tween a speed which will do for press matter in ordinary plain language, and the speed permitted for code and cipher messages.

"Speed" expressed in words per minute is misleading, since five letter words are frequently taken as the basis, whereas in actual practice a telegraphic word averages about eight letters, the increase being due to code words, and the omission of many conjunctions and prepositions when messages are sent in clear. A better method of expressing speed in cabling is in standard letters of a certain number of signals each, transmitted per minute, so that experienced operators can certainly and easily read them. The practical speed is the proportion of the maximum speed which remains after deductions are made for the words transmitted for which no revenue is received, on account of service prefixes, etc., repetitions, errors, corrections, necessary interval between messages, administrative messages connected with traffic, etc. In determining the deductions from the maximum speed to obtain the practical speed in paying words per minute there is little evidence at hand. In the perfected management of the Atlantic cables where keen competition exists, this "dead" traffic has been reduced to sixteen or seventeen per cent of the whole. For a Pacific cable an amount of "dead" traffic as great as 30 per cent at first is estimated, and this could probably be reduced in successive years as it has been in the Atlantic traffic. Assuming 30 per cent for "dead" traffic, and an increase of 90 per cent of speed for duplex working it is estimated that the maximum capacity of the cable in total paying code words, of eight letters each, would be about 11,800,000 per annum. The cost of maintenance and operation, etc., as above being $925,000 per annum, the average cost of transmission per telegraphic word is about 8 cents.

In connection with speed of cabling it may be said that the opinions of the best cable experts in the world as to the theoretical speed obtainable from a given cable over a given distance differs so widely as to inspire caution in making all estimates.

The present commercial rate from Washington to Manila is $2.38 per word. Government rate $2.25½ per word, and the rate for "right-of-way" messages three times the normal rate.

It is seen that at the present commercial rate to Manila, after allowing for present land rates to San Francisco, the proposed cable is required to operate less than fifty minutes per day in order to earn the income of $925,000 per year. Allowing the present rate to be reduced one-half, the cable would have to work less than two hours daily. If the rate per code word, of an average of eight letters, is placed at fifty cents from San Francisco to Manila, then, upon the above supposition, the cable need operate daily less than four hours to meet expenses.

Assuming the cable to be interrupted as much as one-quarter of the entire time, the figures above still appear striking.

The desirability of the cable from an economic standpoint seems unquestioned. The Secretary of War says in his annual report:

"The cable tolls of the War Department messages alone to and from the Philippines for the last five months have averaged monthly a rate of over $325,000 a year."

This alone equals the interest at three per cent on the sum of $10,845,000. It is reasonable to assume that the despatches of the other departments of the Government would at least increase this amount

SAMUEL DANA GREENE.

by one-quarter, which would make the present Government cable tolls to and from the Philippines equal to the interest at three per cent on approximately $13,500,000. Fully 90 per cent of this sum goes to foreign corporations while all Pacific cable expenditures would remain in the United States.

In an ocean cable enterprise the largest item of annual expense is invariably the interest on the capital invested. No one can borrow money at a less rate than the United States Government, and, furthermore, as a Government enterprise, the cable is at once relieved from earning any sums for dividends, and is only required to maintain itself in a prudent and sound financial condition.

After several years of comparatively little advance, the technical and scientific side of telegraphy has received much attention during the past two or three years, until at this moment there is no other special branch of electrical engineering which is more in evidence or promises more for the future.

By whatever method the first Pacific cable is ultimately laid, and provided that it shall appear that all of the projected cable can not be manufactured and laid in the United States within a reasonable time, it seems plain that the encouragement of American manufacturers in the building up in the United States of a deep sea cable industry of the first-class is a wise policy for this Government.

The proprietor of the Berghaupten Colleries at Gengenbach (Baden) is credited with the intention of establishing a central power station, using the coal on the spot in the generation of electric energy for lighting and power purposes in the district.

MR. S. DANA GREENE DROWNED.

AN ACCIDENT RESULTS IN THE DEATH OF MR. AND MRS. GREENE, AT SCHENECTADY, N. Y.

Late in the afternoon of January 8, Mr. and Mrs. S. Dana Greene, while skating on the Mohawk River, near Schenectady, N. Y., were drowned in a large opening in the ice which had been made by ice-harvesters. It is thought that the strong wind blowing at the time forced the skaters into the opening without warning. It was dark and there were no witnesses of the accident. Mrs. Greene was taken from the water unconscious, and died shortly afterward. Mr. Greene's body sunk and was not recovered for several hours after the accident.

Samuel Dana Greene was a son of the late Commander Samuel Dana Greene, who was second in command of the Monitor when she fought the Merrimac, and in full command during the greater part of the battle, owing to the disablement of Captain Worden. General Francis V. Greene, who won fame in the Philippines, is Samuel D. Greene's uncle. S. D. Greene attended a military academy at Tivoli-on-the-Hudson, and later entered the Annapolis Academy, graduating No. 1 in the class of 1883. Soon after graduating he resigned from the Navy and entered the employ of the Sprague Electric Company, of New York. The Sprague Company was merged into the Edison General Electric Company about 10 years ago, which was later consolidated with the Thomson-Houston Company, of Lynn, forming the General Electric Company. Mr. Greene rose rapidly in the electrical business, and at the time of his death he occupied the important position of general sales manager of the General Electric Company.

In 1891 Mr. Greene joined the Naval Militia, and when the war with Spain broke out was Chief of Staff of the First Batallion. He volunteered, and was ordered to the Yankee, on which vessel he served as Lieutenant (junior grade) until the conclusion of hostilities, when he was honorably discharged. The accompanying portrait shows Lieutenant Greene in the uniform of the service. He was then appointed Lieutenant-Commander and Chief of Staff to Captain Jacob W. Miller, commanding officer of the New York Naval Militia. When Governor Roosevelt assumed office, Lieutenant-Commander Greene was selected to represent the Naval Militia on his staff.

Mr. Greene was married in June, 1896, to Miss Cornelia Chandler, of Batavia, a daughter of Admiral Chandler. They had no children.

Throughout the electrical field the personal and business popularity of Mr. Greene was remarkable. Uniting with the most perfect integrity in business matters a cordial manner and a personal charm which endeared him to his associates, Mr. Greene represented the highest type of the young American man of affairs. His untimely death will cause sincere and widespread regret in all departments of the wide field with which he was so prominently identified. To his business associates Mr. Greene's death is a great and irreparable loss.

A NEW METHOD FOR STUDYING HYSTERESIS CURVES IN SAMPLES OF IRON AND STEEL.

BY KNUT ANGSTRÖM.

In a very remarkable paper read before the Konglish Vetenskaps-Akademiens Forhandlingar, in Copenhagen, Professor Angström described a beautiful method of research into hysteresis curves. The following is a translation in abstract of his paper:

The first experimental use of cathode rays in the study of alternating-current phenomena was made by Herr F. Braun. Fig. 1 shows the type of apparatus employed by this investigator in his researches. A glass vacuum tube contains near its middle a metallic diaphragm D pierced at its centre with a round hole facing the cathode K. At the far end of the tube, which is similar to the original form of Crookes tube, a surface of some fluorescent material S is spread. When the tube is operated in the usual way the cathode stream passing through the hole in the diaphragm impinges upon the screen S and exhibits itself as a small and brilliant spot of light. This stream of cathode rays, as is well

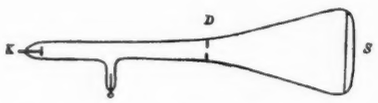
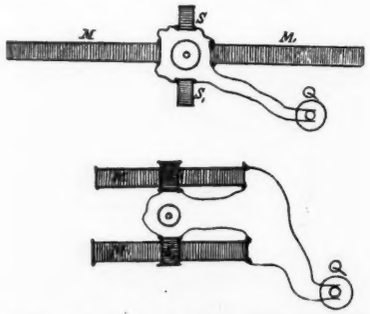


FIG. 1.—STUDYING HYSTERESIS CURVES.

known, may be deflected by an electro-magnet placed near the diaphragm and may be made to act as a weightless and exceedingly sensitive indicator of the strength of the magnetic fields. If two similar electro-magnets are placed at right angles to one another and also at right angles to the axis of the tube near the diaphragm, when an alternating current is sent through them, the form of the path of the bright spot at the end of the cathode stream is, of course, one of Lissajous's curves, and, if the magnets are precisely similar, will take the form of a right line inclined 45 degrees to the magnet system. The author used this simple arrangement with certain modifications in the following ingenious way. When a rod of steel or iron is magnetized in a coil, then, if the magnetizing forces are plotted as abscissae and the induced magnetism as ordinates in a rectangular system or coordinates, the result will be what is known as the hysteresis curve or loop, if the process is carried through an entire cycle up to saturation in both directions.

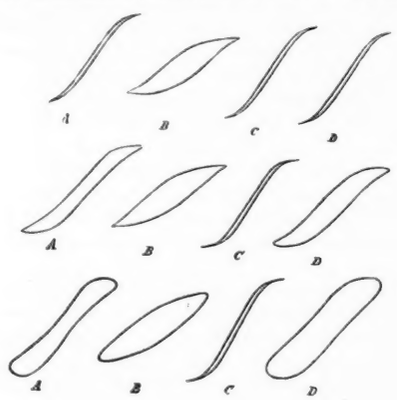
Fig. 2 shows one arrangement, and Fig. 3 another, which was adopted to make these hysteresis curves exhibit themselves. In either diagram, S and S_1 represent coils wound on wooden spools; M and M_1 represent long coils in which are placed samples of the metal to be tested. The axis of the tube is perpendicular to the paper, and the diaphragm, with a round hole in its centre, is seen in the middle of the sketch. At Q is a source of alternating currents. The four coils are connected



FIGS. 2 AND 3.—STUDYING HYSTERESIS CURVES.

in series as shown. It will be seen that the deflection of the cathode rays produced by the coils S and S_1 in a vertical sense are proportional to the magnetizing forces in the circuit, while the horizontal deflection produced by the iron samples in the other coils is due wholly to the magnetic field of the iron contained by them. The superposition of these deflections gives the desired curve.

In Figs. 4 to 6 are shown some specimen curves obtained in this manner. Fig. 4 shows what may be called the static hysteresis curve, produced by taking the sample very slowly through a cycle of magnetization. Fig. 5 shows the curves for alternating currents of above 20 cycles

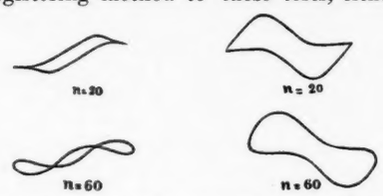


FIGS. 4, 5 AND 6.—STUDYING HYSTERESIS CURVES.

per second, and Fig. 6 for about 60 cycles per second. In all of these illustrations A refers to a rod 10 centimetres long and 3 millimetres in diameter, containing 0.2 per cent carbon and annealed. B refers to a rod of similar dimensions, but containing 0.8 per cent carbon and hard tempered. C refers to a bundle of very soft iron wires of fine gauge. D shows a similar bundle of wires bound on the outer surface of a brass tube. It will be noticed that the effect of hardening is very visible, while little difference between a rod and a bundle of wires is noticeable when both are composed of very soft iron.

If the two long coils are filled with different varieties of iron, then a differential hysteresis curve is obtained which clearly shows the effects of the phase and current variations produced by Foucault currents in the specimen. Figs. 7 and 8 show such difference in curves for frequencies of 20 and 60 periods per second. Fig. 7 is made by the use of the two iron bars described above, while Fig. 8 is produced when the bundles of iron wire, one with and the other without the brass tube, are used.

The author thinks that this simple method is adopted to practical use in testing samples of iron, both for their magnetic qualities and also for their carbon contact. If the two coils containing the specimens are used alone and in them identical samples of iron are placed, the result will be simply a rectilineal vibration of the light spot. The least difference of magnetic quality in the two will exhibit itself by a characteristic curve. It is a matter of great ease to apply a photographic registering method to these tests, either



FIGS. 7 AND 8.—STUDYING HYSTERESIS CURVES.

by the use of a camera or by a flat-ended tube, to which a plate may be directly attached.

Plans are now completed for the construction of a general street railway system which will cover the entire southern part of New Hampshire and also connect the cities and towns on the Merrimac River valley. The old Nashua-to-the-sea scheme, which received a new impetus in the recent organization of the Haverhill & Southern New Hampshire Street Railway, promises to be materialized, and a location has already been secured in Methuen for a part of the line that will cut through a corner of that township. At the New Hampshire line direct connection is planned with the now incorporated Hudson, Pelham & Salem Street Railroad, which will give the direct way to Nashua. The Barnes interests that control the Haverhill & Georgetown Road, the G. R. & I., now under process of construction, and the G. & D., recently organized, are also supreme in the H. & S. N. H. Road, and it is presumable that, if they are now in control of the Nashua end of the system, they at least have some understanding with the powers that be in the Nashua branch. Then the Nashua-to-the-sea line, with Haverhill a central point, is evidently a thing of the near future.

EXPORT NOTES

The Kalgoorlie (Australia) Electric Power Company, which will at first install generators of a total capacity of 4,000 horse-power for supplying electric power for the purposes of pumping, stamping, etc., in a large number of important gold mines within a one and one-half mile radius from its power house, will probably employ large gas engines for any extensions which may have to be carried out. The reason for this is that the water at Kalgoorlie is largely impregnated with salt, which makes its use for condensing purposes expensive.

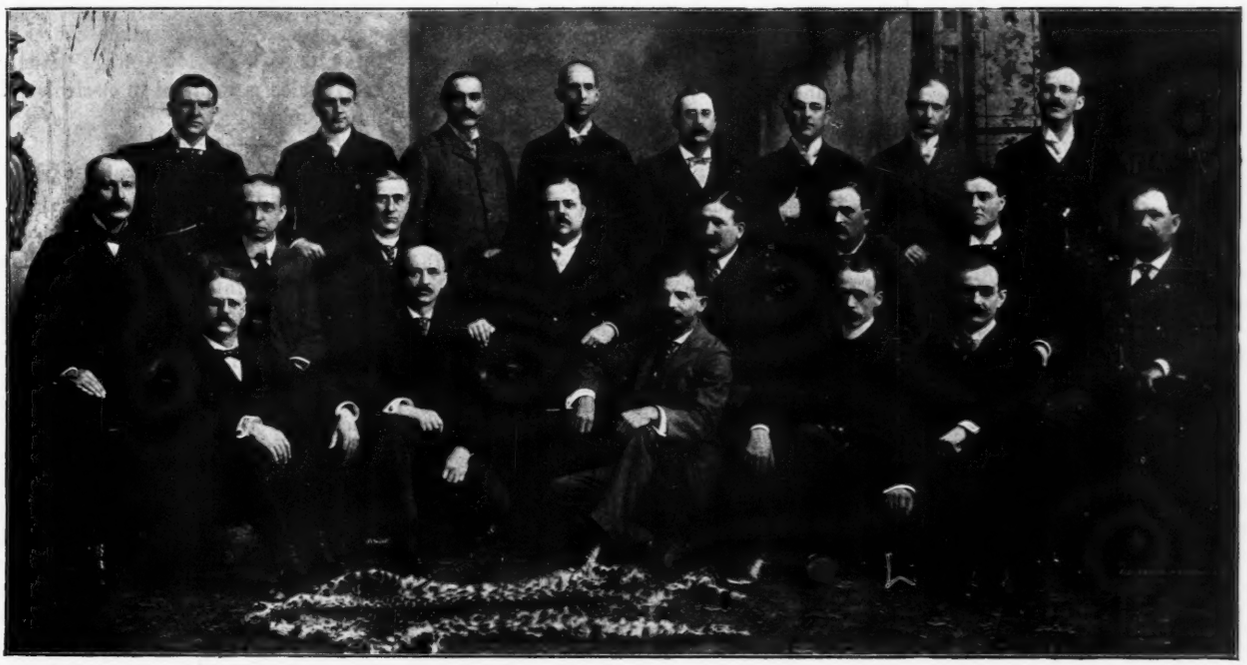
La Sociedad General de Centrales Electricas is the title of a company which has been formed at Bilboa, Spain, with a capital of $1,000,000, to acquire and carry on as a joint concern the central electric stations in the towns of Torrevieja, Real Sitis de San Lorenzo, Escorial de Abajo, Nava del Rey, Medina de Rioseco, Lorca, Almaden, Marchena, Arahal, Paradas, Cebredos, El Tiemblo, San Martin de Valdsiglesias and Santander. At each of these towns extensive improvements will be made by the company, so an idea of what their needs may be can be judged by the number of places in which the company controls the electrical plants.

The trade in goods coming in small parcels by mail from the United States to and through this port has been rapidly increasing of late, writes United States Consul-General James Goodnow, from Shanghai, China. More care, however, must be taken in packing such goods. In the last mail there was a large number of these packages sent as registered mail, and in almost every instance they were received at this office broken. Most of them were in paper boxes; some were in wooden boxes. All such were broken. Shippers must remember that mail sacks are liable to rough handling in being put into the hold of ships, and that much more care must be taken in wrapping goods for China than for points in the United States. In this mail I noted especially one shipment of eyeglasses, packed in a wooden box of flimsy make. The box had collapsed, the paper wrapping had broken, and the glasses were scattered through the bag, some being broken. The fault was entirely due to careless, slipshod packing.

A company has been formed at Rome, Italy, named La Societa delle Tramviee Ferrovie Elettrichi de Roma, with a capital of $300,000. The company has made application to the authorities of the Province of Bari for a concession to build a railroad between Taranto, Manduria and Lecce. Electrical and mechanical undertakings in Italy are making extensive advances. Information received shows that during 1900 a still greater movement in this direction will be inaugurated, not only among private concerns but also in many branches in which the government is interested. The Italian naval authorities have just placed contracts for more than 27,000 tons of steel warship material with the Terni Steel Works, at Terni. The authorities of the Ferrovil delle Mediterranea have just closed a contract with Miani, Silvestre & Company, of Milan, for 10 six-wheel compound locomotives. New works for the manufacture of horseshoes have just been completed and put in operation in Venice. The plants which are increasing their capacity in Italy, and consequently adding new machinery and tools, are said to be numerous.

A Group of Prominent Telephone Officials.

In the handsome illustration presented on this page are shown the portraits of twenty-one prominent officials of the Erie Telegraph and Telephone Company, whose executive offices are at Lowell, Mass. This company, known as the "Erie System," is the largest licensee company of the American Bell Telephone Company, and its territory covers a large part of the Middle West and Southwest.



A GROUP OF PROGRESSIVE TELEPHONE MEN—OFFICERS OF THE ERIE TELEPHONE SYSTEM.

William J. Berry. James F. Land. Erie K. Baker. Charles L. Boyce. Joseph E. Farnsworth. Charles E. Nestor. Frederick A. Forbes. George D. Sherman.
Peter G. Reynolds. Charles A. Gates. James P. McKinstry. CHARLES J. GLIDDEN, PRESIDENT. Heman J. Pettengill. Darius F. Morgan. Charles E. Wilde. Charles P. Wainman.
Elisha W. Bennett. Peter Yensen. Thomas L. Powell. Edward D. Trowbridge. Edwin B. Cottrill.

The company's president, Mr. Charles J. Glidden, whose portrait appears in the centre of the group, is a pioneer in the telephone field, and one of the most successful men in the business. His ability as an organizer and manager is shown in the results he has accomplished.

The Erie Telegraph and Telephone Company is the largest in America operating under the Bell patents. It has 106,564 subscribers, having made a gain during the year just closed of 43,714, or $69\frac{55}{100}$ per cent. The "Erie System" operates in North and South Dakota, Minnesota, Wisconsin, Michigan, Arkansas, Texas and Cuyahoga County in Ohio, which includes the city of Cleveland.

ELECTROLYTIC PRODUCTION OF ALUMINUM.*

BY G. H. ROBERTSON.

The methods for the production of aluminum by electrolysis may be divided into two classes, those in which the bath is formed by a solution of its oxide, and those in which it is the sulphide that is dissolved. The former methods are based on the discovery by Deville in 1859 that aluminum can be prepared by electrolyzing fused cryolite, the composition of the bath being maintained by the dissolution of anodes of carbon containing alumina. But this process did not come into commercial use owing to the high cost of electrical energy, and aluminum continued to be produced for some time longer by the chemical method based on the decomposition of aluminum chloride by metallic sodium. In 1886 Hall in America succeeded in obtaining aluminum by the electrolysis of fused cryolite, which he found was specially adapted to the purpose from its low fusing point. Almost simultaneously Heroult obtained a patent in France for practically the same process and since then, owing to the cheapening of the cost of electrical energy and improvements in the processes, the electrical methods for the production of aluminum have superseded the chemical. The cost of electrical energy for effecting metallurgical reductions at the high temperature required for the fusion of the oxide of aluminum is high, and therefore efforts were made to find an electrolyte whose chemical reactions would assist in the reduction. This lead to the reintroduction of the sulphide process originally patented by Petitjean in 1857. In 1892 Bucherer succeeded in decomposing aluminum sulphide electrolytically, and worked out a process by which this might be cheaply produced on a large scale, which consisted in heating carbon and sulphur with aluminum oxide to a white heat in a fire-clay retort. The reaction is represented by the equation—

$$Al_2O_3+3C+3S=Al_2S_3+3CO,$$

and is endothermic, the calories absorbed being 180,500. Since the heat of combination is only one-third of that of the oxide, it is evident that it can be more easily reduced electrolytically, and therefore it is not surprising to find that different attempts have been made to improve on the original sulphide process. In February, 1897, Mr. Blackmore read a paper before the New York section of the Society of Chemical Industry, in which he described a process which involved the conversion of aluminum oxide into the sulphide by means of carbon bi-sulphide, and one of the chief points connected with the invention was the cheapening of the cost of production of the latter substance. Instead of iron vessels Mr. Blackmore employed earthenware ones, which he impregnated with lead salts, which became converted into the sulphate and protected them from the corrosive attack of the carbon bi-sulphide. By the substitution of aluminum sulphide for its oxide, Mr. Blackmore claimed that the voltage required to effect decomposition was reduced from the five volts employed in the Hall and Heroult processes to 3.8 volts, and that by his method of manufacture, the cost of aluminum sulphide is reduced to six cents per pound. The most recent sulphide process is that patented by Mr. Gooch, who claims for it that, in contradistinction to existing processes in which aluminum sulphide is either formed without the bath and then added to it or else formed from alumina suspended in the bath, he forms it from the aluminum oxide dissolved or combined in the bath, which is prepared as follows: Three parts sodium fluoride to two parts aluminum chloride are fused in an iron tank provided with sleeves for the insertion of the anodes, and lined on the bottom and half way up the sides with compact carbon. The remainder of the tank and the sleeves are lined with compact alumina, which serves to keep the anodes from electrical contact with the tank and casing. The anodes, which are perforated longitudinally, are formed of carbon, and partially immersed in the bath, and connected by copper rods to a metal bar, which rests on wooden supports. The carbon lining serves as the cathode. The carbon bi-sulphide is introduced into the bath through pipes which form tight joints with the anodes, so that the pipes are continuous with the perforations in the anodes. The gaseous products escape from the bath through a bell made of boiler iron plate and lined with compact carbon, which is suspended from the bar over the bath, so that its opening can be lowered below the level of its surface when it is in operation, and the space between the rim of the bell and the interior surface of the tank is covered with powdered carbon sprinkled thickly on the surface of the bath. Through this space, when desired, alumina is introduced into the bath in the quantities required. A moderate excess does no harm. When the carbon bi-sulphide is introduced it acts on the dissolved alumina to convert that oxide to aluminum sulphide, while carbon oxy-sulphide or carbon monoxide is formed at the same time. Then an electrical current of suitable low voltage (which will vary according to the constitution of the bath and the size of the electrodes) is passed through the bath, thereby electrolyzing the solution. The aluminum deposited at the cathode is removed by ladle or siphon, while the sulphur liberated at the anode passes off through an outlet in the bell. By supplying alumina to the bath, and maintaining the current of carbon bi-sulphide, the production of aluminum sulphide goes on continuosly, and, if properly regulated, keeps pace with the electrolysis. One advantage claimed for this process is the low voltage (about 0.9 volt) which is required to electrolyze aluminum sulphide.

* From the London *Electrician*.

Trade with Central Italy.

In a British consular report on the trade of Central Italy during 1898, just issued by the British Foreign Office, there is considerable information and data of value to American manufacturers which demonstrate to what extent that trade has increased and also what is necessary in order to secure and maintain the trade. Since 1897, the report says, there has been revival in the commercial intercourse between the United Kingdom and Italy, so much so that while the total British imports in 1897 amounted to £1,934,440, they rose in 1898 to £10,155,200, showing an increase of £8,220,760. Various are the causes which have determined a change for the better in the general conditions of Italy, chief among which are the ideas lately prevailing as to colonial expansion, and also general retrenchment in public expenditures. It would be wise, the report states, for British exporters to take advantage of the present favorable circumstances in order to improve their position in Italy, and thus follow the example of other countries, chiefly Germany. The employment of commercial travelers having competent knowledge of the Italian language and the formation of local agencies have already been suggested by one or more colleges in Italy, and there is every reason to believe that these two suggestions, if carried out, would prove successful. It is further stated that British exporters would help in establishing in Rome a British Chamber of Commerce with samples depot attached. The question of decimal weights and measurements for Italian customers is also a vital one. So small is the trade which has been transacted with the United States that the English do not as yet consider the American competitors in that field. The Germans, Belgians and French are all endeavoring to increase trade with Italy.

NOTES ON LIGHT.

BY WILLIAM ROLLINS.

NOTE LXXXI—REPUMPING TUBES.

A powerful generator soon makes a tube useless. Repumping revives it for a short time only. The reasons have been given in former notes. The remedy is to fill the tube with illuminating gas, until the hydrogen has combined with the terminals, and then repump.

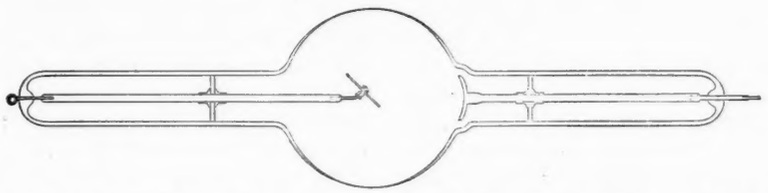


FIG. 69.—A-W-L X-LIGHT TUBE, WITH ROTARY TARGET AND ELECTROLYTIC VACUUM REGULATOR.—SCALE ¼.

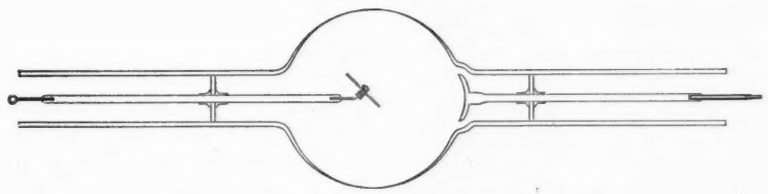


FIG. 71.—PARTIALLY FINISHED TUBE—SCALE ¼.

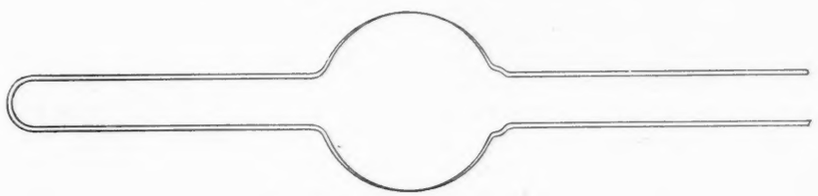


FIG. 70.—GLASS BULB—SCALE ¼.

NOTE LXXXII—APPEARANCES OF PERFORATED TERMINALS IN VACUUM TUBES.

In previous notes perforated terminals were mentioned. I now understand that the appearances seen with these were first observed by Goldstein but remained unexplained. The following statement is therefore given: The particles of hydrogen being shot off perpendicularly from the sides of the openings approach each other, but having charges of like sign are mutually repelled, the curve of motion being a resultant of these two forces. Usually the phenomena take the appearance of somewhat pointed flames. That they stream backward from a concave cathode is but natural.

NOTE LXXXIII—HYDROGEN IN METALS.

I made cathodes of most of the common metals to study their behavior under electric stress, finding hydrogen in most, even where its presence was not mentioned in the works on chemistry I had. In zinc, for example, it is so abundant and amalgamated in such a way that this metal makes a good cathode so far as the production of X-light goes. In those metals which are solids at ordinary temperatures and where it is not abundantly present the cathodes are likely to melt suddenly when much stress is used. This is an interesting illustration of the direct conversion of electricity into heat. The electricity does not escape for there are only the particles of the metal to carry it, and these being heavy are not so efficient as the light particles of hydrogen.

NOTE LXXXIV—REDUCING THE COST OF X-LIGHT TUBES.

I hope to see every physician use X-light. To hasten the coming of this happy day it is necessary to make the tubes cheap as well as durable, efficient and graceful. In this note, some of my attempts, though not the most recent, are mentioned. The tube shown in Fig. 69 is made from one piece of glass. As the bare stems of the terminals balance on the mica disks, when sealing in, their weight does not cause them to drag on the soft, hot glass. The operation is in consequence a simple one which may be done by cheap labor. If the tube is provided with a rotary target and an electrolytic or chemical hydrogen regulator it will last for a long time. When blackened, perforated, or broken it is a simple matter to remove the terminals, after soaking them in hydrogen, putting them into a new tube which need not be expensive, for one company says it will make bulbs like Fig. 70 for fifty cents. It is a simple matter to cut off the ends as in Fig. 71, sealing in the old terminals, thus making almost a new tube. This is a point of practical importance, as a blackened bulb makes the action of a tube irregular by absorbing and giving off gas, and the metal acting as a conductor diverts part of the current, diminishing the efficiency. In the ideal tube all the energy is concentrated in the cathode discharge and delivered on a small area of the target.

ELECTRICAL MEN OF THE WEST.

NORTHWESTERN ELECTRICAL ASSOCIATION'S CONVENTION.

The Northwestern Electrical Association will meet at the Hotel Pfister, Milwaukee, Wis., on Wednesday morning, January 17. Secretary Mercein has just sent out his "last call," thus: "A large and interesting meeting is assured. One and one-third round trip rate on the certificate plan has been granted by the Western and Central Passenger Associations for the occasion. Write to James Wolff, chairman, 320 Dearborn street, Chicago, for special train and car arrangements, and to manager Hotel Pfister for rooms, exhibit space, wiring and current. Secure your hotel accommodations in advance. Mail to me now all questions you want answered at the convention. The best brains and experience of the Northwest will be there to give you information. The managers of all the McMillin electrical plants will attend our convention after their annual meeting the day previous. Theatre parties, etc., Wednesday night. Our annual banquet Thursday night. Come and bring your friends. All electrical men welcome."

Following is the list of papers for this meeting:

"Modern Development in A. C. Series Arc Lamps," by R. Fleming, Lynn, Mass.; "Alternating-Current Phenomena," by Professor Jackson, Wisconsin University; "Combination of Electric Lighting and Hot-water Heating Plants," by W. H. Schott, Chicago, Ill.; "Central Station Economies," by H. W. Frund, Vincennes, Ind.; "Induction and Direct-Current Motors," by Ralph D. Mershon, New York, N. Y.; "Relative Desirability and Efficiency of Various Types of Engines on Central Station Loads," by Professor Richter, Wisconsin University; "A Life Test of Incandescent Lamps." by Professor Shepardson, Minnesota University; "A Canadian Plant," by L. G. VanNess, Quebec, Canada.

TRAMWAYS AND THE HOUSING OF THE WORKING CLASSES.*

A BRITISH VIEW OF THE SOCIAL IMPORTANCE OF ELECTRIC TRACTION, BY GRANVILLE C. CUNINGHAM.

One of the most important problems of modern times is how to overcome the congestion of population in the central parts of our large cities. As cities increase in population—and never has the increase been so great as within the last 20 years—the congestion at the central parts and in what are called the working-class districts becomes more pronounced and more serious. The reasons for this are obvious. As the population grows and what were formerly residential streets are occupied by shops and factories, the former residents of the better class move out further into the suburbs. These comprise, besides rich merchants and professional men, smaller tradesmen, clerks and shop assistants. These are able to move out because, first, their income allows of their using some means of getting to and from their employment, such as a twopenny or threepenny 'bus, or the more costly long-distance ride by railway train; and second, because their hour for beginning work is such that they are enabled to use such means of locomotion. They do not require to be at their places of employment until eight, nine, or ten in the morning. By these hours 'buses, trams and suburban trains are in full swing and are bringing their passengers to work. It is otherwise with the ordinary working man. With the occupation of streets, formerly residential, by shops and factories, with the influx of additional working men required by these shops and factories, he and his brethren are pushed down to the centre and crowded more tightly together. He can not, like the other classes of the community, move two or three miles out into the suburbs away from his work because he can not afford to pay a fare of 2d. or 3d. on a 'bus or tram, nor could he afford the long time and the exertion required to walk such a distance. He is therefore forced, in order to be sufficiently near his work, to crowd in with others of his class in the central parts of the city. This process has been going on with increasing force in all our large cities, until the congestion in many places has become a crying evil, while at the same time the rents charged have, owing to competition, inevitably increased. There is literally "no room to live," and numerous instances could be cited of working men being unable to find even a hole or corner to live in at the necessary proximity to their work, at no matter what rent. The necessary result of this is insanitation, misery and disease, and while the popular clamor for the better housing of the working classes goes forth, the very growth in material prosperity of the nation seems necessarily to result in their worse housing. Now, how are these ills to be cured? How is the working man to be housed in a reasonably comfortable and sanitary fashion, at a moderate rent, and yet within convenient distance of his work? These are the vital problems for him. The air is full of solutions. Some say, "Establish land courts and force the land-lords to accept a reasonable rent," or, in other words—for this is what it means—such rent as the working man is willing or able to pay. Others say, "Pull down the houses and build better at the public expense, and rigidly fix the number of inhabitants." The first solution would be no solution at all, or even if the rent was reduced by one-half the room would not be increased, and it is want of room that is the prime cause of the evil, while the trouble and overcrowding would soon appear again in sub-letting. It is useless to attempt any solution in the face of economic laws. You can not make water run up a hill. The second solution is too utopian to be practically applied. Besides, the same objection holds; the room is not increased, and it is increased room that is required to remove congestion. By forcing men away as much evil is done as is cured.

There are only three ways in which congestion can be removed. Either by building up, building down or spreading out. To build up, and by constructing towering buildings of 15 and 20 stories, thus to give more room, would be practically impossible in England, and if possible would be highly undesirable. The cost would be so great as to preclude moderate rents; the interference with "ancient lights" and the insanitary effect of such vast buildings in crowded quarters and narrow streets would be a further bar. To construct cellar dwellings would be still more out of the question. The only practical alternative is to "spread out." This in its application means inducing the working classes to move to the suburbs and there to occupy houses spread over a larger and roomier area. Rents in such a locality would necessarily be less because the site is less valuable and the strain of competition is removed. Congestion would be abolished, because there would be then room to live. But as pointed out before, the bar at present to this moving out to the suburbs is that the working man can not afford to pay 3d. morning and evening to be carried to and from his work, nor can he afford the time or energy to walk a distance of three or four miles. If, however, a cheap and rapid means of transit can be supplied, the problem is solved. And it is here that the modern electric tramway comes to his rescue. Cheap and rapid transit is the cure and the only cure for the overcrowding of the working classes. If a man can be carried morning and evening three or four miles for a penny, and at a speed of eight to ten miles per hour, then he can afford to live in the suburbs in sanitary conditions, and travel backwards and forwards to his work night and morning. There is absolutely no other solution to the overcrowding problem but this. Give the means of getting quickly and cheaply from the centre to the suburbs and workmen's dwellings will soon grow up in roomy places and congestion will disappear. Withhold these means and congestion and overcrowding will continue in spite of all legislative enactments.

But the means must be cheap for long distances, the service rapid and frequent, and comprehensive enough to reach all parts of the city from any other part. When a man can be carried four or five miles for a penny, when he knows that he can cover that distance in half an hour or less, that cars are running every two minutes, that once he gets on a car he is able to reach any part of the city he wishes to go to, then it will pay him to go out to the suburbs, because he will live in a better house at a lower rent, and yet remain in perfect contact with his work.

It is strange that facts such as these have hitherto commanded so little attention in England—a country where their significance is so important. On the American continent their full force was at once recognized, and the marvelous growth of electric tramway systems was simply the supplying of a great popular need. Electricity was the chief motive power that every large community required, in its application to tramways, to give cheap and rapid transit, spread out the population and bring airy and sanitary houses within the reach of the working classes It was seized upon with avidity, and every reasonable facility given to tramway companies to extend their operations and to bring their cars to the service of all. The tramway was recognized as not only a useful but as an essential factor in the life of every large town. Figures could easily be quoted showing how rapid has been the increase in the number of passengers carried in all large places where electricity has been introduced, evidencing the great popular need that has been supplied, but it may be sufficient to give the following examples of typical transatlantic cities:

*From the London *Tramway and Railway World.*

TRAMWAY PASSENGERS CARRIED.

	1892.	1898.
Boston, U. S.	126,000,000	181,000,000
Buffalo, U. S.	21,500,000	43,000,000
Providence, U. S.	23,000,000	35,000,000
Montreal, Can.	11,500,000	35,000,000
Toronto, Can.	19,000,000	29,000,000

How different it has been in England! Though there are no towns in the world that would benefit more than the English by the construction of comprehensive and complete electric tramway systems, and that stand more in need of them to relieve overcrowding, their introduction has been slow and halting, and carried out in the face of bitter opposition. Instead of lending a helping hand, municipalities seem to think they are doing the public service by balking or obstructing all enterprise, or by narrowing it down to the smallest possible limits. The introduction and development of the "municipalization of trams" idea has still further cramped all expansion. The municipality fixes its mind upon the small profit that may be made out of working the tramway system, talks grandiosely about the reduction in rates that may be affected by this profit, and is willing to forego for years the benefit of a comprehensive and up-to-date tramway system for the sake of ultimately securing to itself this profit, forgetting or being ignorant of the fact that the real advantage to the community is in having cheap and rapid transit over a comprehensive tramway system irrespective of who the actual owners of the tramway may be. There is, perhaps, nothing that has done so much to prevent the relief of overcrowding and congestion as the Tramways Act of 1870. Its provisions in rigidly limiting the term of the concession to 21 years, and practically fixing the price at which the municipality may take over the undertaking at something far below its value, have effectually checked the growth of electric systems.

To spread out the community it is necessary that the tramway system should give a cheap, rapid and comprehensive service. In England the uniform fare for long distances as well as short has always been objected to, but it is essential for the extensive use of the system that the uniform low fare should be adopted. It is the "penny all the way" that induces passengers to travel long distances, and to travel in large numbers. It is small benefit to a man to be carried half a mile for a halfpenny, but it is a benefit to be carried four miles for a penny. From the tramway company's point of view it is an advantage to have large numbers use the long distance, for every one who lives out far becomes dependent on the cars and must use them, and the cars are filled steadily. It is the receipts per car-mile that are the proper consideration for the company; so long as these keep up it matters not if they are obtained by carrying a large number of people at a small fare, or a small number of people at a large fare. But the difference to the public is very great and very important; the large number at a small fare means the spreading out of the population and the relief of congestion and overcrowding.

The low cost of working electric trams, as compared with horse, makes it possible to have less receipts per car-mile and get a much larger profit.

The service must be rapid, for if not, the loss of time in traveling long distances would be a serious bar to the regular use of the trams by working men. To them time is money, as much as to any other class of the community.

The service must be comprehensive; that is to say, a piecemeal system, that runs in on one street and then stops and breaks off, or that serves one or two districts and leaves others untouched, is of little use. The system must serve all parts of the town, so that ready access can be obtained from one to the other, and that a working man living in any one part can readily reach another.

Electric trams are the only means of abolishing overcrowding and congestion. This has been their effect on the American Continent. Their introduction in England on a similar scale would have the same effect. Doubtless there are great and even insuperable difficulties to their introduction upon the street surface in the central parts of London, or even near the central parts, but special means can be used for London and still preserve the essential features of cheapness and rapidity. Though there are numerous large towns and cities in England that are very much in need of "spreading out," there are none, of course, where the congested condition is so bad as in London. Here something must be done before long, or the arteries will become so choked that life will be impossible.

LOOKING ACROSS CITY HALL PARK AT DUSK FROM A WINDOW IN THE ELECTRICAL REVIEW OFFICES.

Trolley Competition with Steam Railway.

The New York Central management is said to have determined upon a new line of policy with regard to the numerous trolley lines which, for some time, have been cutting into the local traffic of the steam railroad in the interior of New York state. Heretofore, the New York Central has not recognized the suburban electric roads as competitors, and has made no deviation in its usual methods of operation. President Callaway and his assistants now find it necessary to protect the interests of their road against the cheaper transportation facilities of the trolleys.

Wherever it is apparent hereafter that the electric roads are getting passenger traffic away from the New York Central the local train service of the Central will be increased and fares for short distances will be scaled down. In the vicinity of such cities as Buffalo, Rochester, Syracuse and Albany the country is gridironed with trolley lines for several miles around, and a large proportion of the travel that used to be monopolized by the New York Central has been diverted to the cheap and numerous trolley cars.

The passenger traffic between Buffalo and Niagara Falls has been in a large measure taken from the steam railroads by the electric cars. It is purposed by the New York Central management to win back some of this traffic by increased train service and special rates of fare.

The policy to be pursued by the New York Central in competing with the electric railways is similar to that adopted not long ago by the Delaware & Hudson. In Connecticut the New York, New Haven & Hartford Railroad has tried to solve the trolley competition problem in various ways. In some instances ownership of the electric roads has been acquired by the steam railroad.

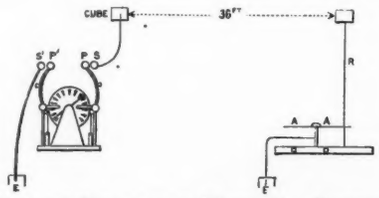
SCIENCE BREVITIES

Power Gas from Wood—A method of preparing gas for motive power and heating from wood is described in a paper recently read before the Societe Industrielle du Nord de la France, by M. Letombe. Ordinarily a very complicated system of purification is needed when gas is prepared by distilling wood; but M. Riche has found that by passing the gas over red-hot charcoal this complication can be avoided. The gas obtained is of low illuminating power, but has a comparatively high calorific value, and may, therefore, prove of service in regions where wood is cheap. The by-products are valuable.

Inflammable Concrete—A curious and inadvertant experiment has been made at the Chester electricity works on the inflammability of concrete, says a British contemporary. It seems that in this station the concrete used for the boiler foundation consisted of about one part in seven of boiler ashes. The usual brick lining for the concrete was omitted, and as a consequence, the whole block of concrete was ignited. Naturally the combustion was slow, owing to the want of draught, but the concrete is said to have become red hot. In consequence of this, the whole foundations of two boilers have had to be taken out and the boilers dismantled. This is a point worthy of note, especially with the concrete used, where a fire-proof structure is required.

Influence of Roentgen Rays upon Selenium—That the Rœntgen rays reduce the resistance of selenium is a discovery of some importance; and it is strange that it was not made before, since the corresponding action of light has been known for nearly thirty years, and was utilized by Graham Bell for his "radiophone" as long ago as 1878. M. Perreau has described in a paper before the Academie des Sciences, abstracted in the *Electrician*, the simple and obvious experiment of exposing a selenium cell to the action of an X-ray tube, at a distance of five centimetres. Its resistance fell "rapidly" from 40,000 ohms to 34,000 ohms, and kept oscillating slightly about the latter value, owing, probably to variations in the intensity of the rays. When the rays ceased, the cell regained its normal conductivity more slowly than it does after the impact of light. The reduction in the resistance was the same as would be produced by a gas jet placed at a distance of 1.5 metres. The action of the Roentgen rays diminished with increasing distance, but was still sensible at 17 centimetres. The author made sure that the effect was not due to secondary causes. Electric waves do not affect the resistance of selenium. This newly-discovered property of the rays might be utilized for measuring their intensity, for which purpose it would have several advantages over photographic or ionization methods.

Wireless Telegraphy Without a Coherer—Mr. W. G. S. Barber Starkey contributes to our London namesake an interesting little article on the above subject: The transmitting apparatus consists of an ærial wire surmounted by a metal cube, electric oscillations being excited in the ærial conductor by sparks from a Wimshurst machine, arranged as shown in Fig. 1. The knobs, P P¹, of the machine are separated so far that a spark can not pass between them, but the sparks can pass across two short spark gaps, P¹ S¹, leading to earth and P S leading to the ærial conductor. The earth connected knob, S¹, is held in the hand by an insulating handle, so that sparks can be evoked when required by bringing S¹ sufficiently near to P¹. The receiving apparatus, Fig. 2, consists of a delicately-suspended needle, A A, preferably made of silverfoil, and the pivot on which it is suspended is connected to earth. Near one end of the needle is mounted a second ærial conductor, R, with a cube on the top similar to the transmitting conductor. This conductor is mounted on an insulating stand. The end of the needle is adjusted so that it is quite close to the conductor, R, but is not in contact with it. When sparks pass at the transmitter the end of the needle, A A, is strongly attracted by the conductor, R. This movement of the needle can be utilized to ring an electric bell. A metal stop forming one terminal of the electric bell circuit is fixed on the baseboard, D, so that the needle strikes it as it approaches the conductor, R, the other terminal of the bell circuit being connected to the pivot of the needle. The author has succeeded with this apparatus in ringing an electric bell at a distance of 36 feet. At that distance the effect was strong, and promised to be available at much greater distances, which, however, have not yet been tried. The movement of the needle, A A, is not due to an electrostatic field as in the well-known experiments of Henry, for no movement is observed till the sparks pass at the transmitter. The considerable distance at which the metallic needle is influenced also points to the action being due to electric waves. The interesting point about the experiment is that the electrostatic attraction on the needle caused by the electric surgings in the ærial conductor should be sufficient to close an electric bell circuit. This new electric wave detector is not likely ever to be so sensitive as the coherer, but its range might no doubt be considerably increased by improvements in details. The height of the ærial conductors employed was about eight feet. Two small Leyden jars were used with the Wimshurst machine. In another form of his apparatus, Mr. Barber Starkey suspends the silver needle by a fine wire from an insulating stand, and connects the attracting conductor to earth.



WIRELESS TELEGRAPHY WITHOUT A COHERER.

Velocity of Cathode Rays and Conductivity of Gases—Signori A. Botelli and A. Stefanini, writing in *Nuovo Cimento*, describe experiments made to determine the velocity of cathode rays. They used a very long, cylindrical tube, at one end of which was the cathode and in the side near it the anode. Along this, at distances of fifty centimetres, were inserted sounding electrodes which could be connected with a quadrant electrometer of small capacity. By means of a very rapid interrupter, the speed of which was known, they determined the time required for the traveling of the cathode ray to the various electrodes, and thus determined the velocity of the rays. It was found that under a pressure corresponding to 0.005 millimetres of mercury, requiring a potential difference of 25,000 volts, the velocity of the cathode rays was about 60,000 metres per second; under a pressure of 0.001 millimetres, and with a potential of 120,000 volts, the velocity was 120,000 metres per second. In both cases the velocity was constant throughout the length of the tube. These values are of the same order of magnitude as those determined by J. J. Thomson and Majorana, but do not agree with the more recent work of the former, who deduced from the curvature of the cathode stream, when traversing a magnetic or electrostatic field, a velocity scarcely inferior to that of light. The authors reconcile these results by the suggestion that the cathode stream is a superposition of two phenomena—one the actual transport of material electrified and ionized particles with a relatively small velocity, and the other a wave motion in the ether propagating itself with high velocity.

VIEWS, NEWS AND INTERVIEWS

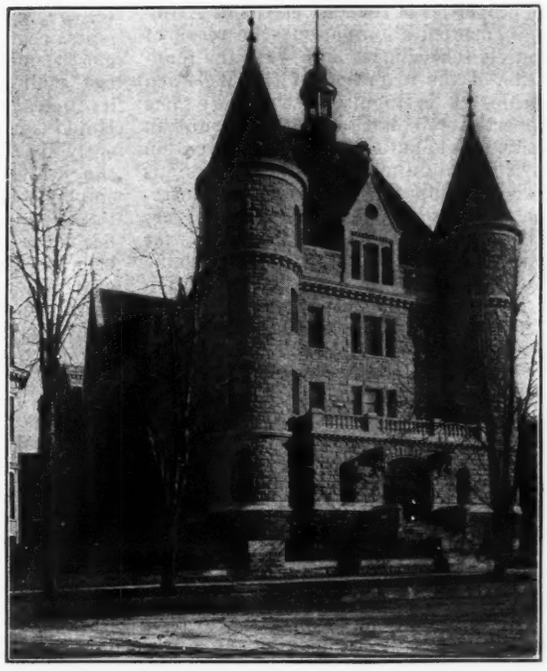
An electrical device for automatically feeding a horse has been invented by an enterprising resident of Youngstown, Ohio. It consists of an alarm clock connected by wire to a hopper in the horse's manger. The alarm clock is set at any desired hour, the hopper filled with oats, and at the appointed time the alarm clock, by means of an electrical apparatus connected with it, releases the oats in the hopper and out rolls the breakfast under the astonished horse's nose.

The first congress of Russian electricians, convoked on the authority of the ministers of the interior and finance, is to be held at St. Petersburg from December 27 to January 8, under the auspices of the Societe Imperiale Technique de Russie. The objects of the congress are the promotion of intercourse between Russian electricians, the demonstration of the most recent electrical inventions, the study of the present state of the industry, etc. At the same time and place there will be held an exhibition of the most modern electrical apparatus, which will be international in character. Foreign exhibits will be admitted free of duty, on condition that they are removed from the country within one month from the close of the exhibition.

John P. Martin and the stock company which owns the Martinique Copper Mines at Tucson, Arizona, of which he is manager, made more than $60,000 the other day through the failure of a messenger boy to deliver a telegram. A three days' option on a block of Martinique stock had been given to representatives of a syndicate of Boston and Baltimore investors, which was to expire at midnight of the third day. On the evening of the last day, Mr. Martin and his son waited until midnight, but did not receive an expected telegram. Negotiations were begun the next day with other persons. Leon O. Bailey, counsel for the Boston and Baltimore investors, called on Mr. Martin later to complete the deal for the syndicate. He was astonished to learn that a telegram he had sent had not been delivered to Mr. Martin. It was learned that the telegram had been put in a rack in the elevator car. From there it had been stolen.

Experts' reports during the three days allowed to the syndicate had caused the quoted values of the shares involved to rise $66,666 higher. Mr. Martin refused to complete the deal as he considered the undelivered telegram an inadequate notice. He, however, paid Mr. Bailey $5,000 to release him from all claims. Mr. Martin will not sue the telegraph company.—*The New York Times.*

A cablegram from the Congo the other day said the telegraph had been stretched along the river as far as Equatorville, the station on the bank of the river where the equator crosses the Congo. There is now telegraphic communication from Banana, at the mouth of the river, to every station of the Free State for 830 miles inland. In other words, the line now in operation is only about one hundred miles shorter than any of our lines connecting New York city with Chicago. The line is to be pushed right up the river until it places all the white stations on its bank in communication with one another. We can scarcely imagine how steam and electricity have revolutionized business affairs on the lower and middle Congo in the past two years. When a package of freight arrived at the mouth of the river for Equatorville in 1897, it had to carried for about three weeks on the back of a porter before it was placed on a steamer going to Equatorville. It was at least twenty-four days on the way from the mouth of the river. To-day the package is carried by steam all the way, and though neither trains nor steamboats run at night, and their rate of speed is low, it takes only five days to move the freight to Equatorville. In other words, nearly four-fifths of the time required two years ago is now saved, and the instant it reaches its destination, the news of its arrival may be flashed to the point where it entered Africa.



MAIN BUILDING OF THE INTERNATIONAL CORRESPONDENCE SCHOOLS.

Operations for widening the Delaware Division Canal will shortly be commenced between South Easton and Bristol, with a view to running the canal boats by electric motors next season, for which purpose a large power house will be erected at Raubsville, Pa.

A Correspondence School of Electricity.

The method of instruction in the industrial sciences by means of correspondence is only nine years old, yet it has met with such warm appreciation that to-day the original school, which was founded in Scranton, Pa., in 1891, by Mr. Thomas J. Foster, has over 115,000 enroled students. This institution, the International Correspondence Schools, is giving instruction in electricity, leading up to graduation as an electrical engineer, a factory artisan, railway or other machinist, draughtsman, etc. The recently-erected main building of the schools is shown in the accompanying illustration. The subjects in which instruction is given in these courses are arithmetic, reading of formulas, geometrical drawing, mechanical drawing, mensuration, logarithms, algebra, geometry, trigonometry, mechanics, hydromechanics, pneumatics, heat, steam and steam engines, strength of materials, applied mechanics, machine design, principles of electricity and magnetism, electrical measurements, batteries, applied electricity, electric transmission, dynamos and motors, railways, lighting, dynamo machine design, motor design, theory and design of all alternating-current apparatus, electric light wiring, bell work, telegraphy and telephony. The various outfits of electrical apparatus are supplied by the school to students without extra charge. The great success which has attended the students of the school in their practical work is best attested by the fact of its continual growth and constantly increasing enrolment of pupils.

After much negotiation the Societa per L'Illuminazione Elettrica di Chiavenna has, under certain conditions, agreed to dispose of its rights in the water-power of the River Liro to the Societa delle Ferrovie Nord-Milano. The latter company intends to establish an electric power plant of 3,000 horse-power, and to transmit the electrical energy generated to Como, whence it will be distributed for traction purposes as desired. One of the first lines on which electric traction is to be adopted is that between Chiavenna and Lecco.

PRESENT ELECTRICAL TENDENCIES.

BY PROFESSOR SYLVANUS P. THOMPSON.*

In telegraphy, the oldest branch of our profession, there is not much room to chronicle change. Nevertheless there is an obvious tendency to increased use of automatic methods of sending. Slowly, but surely, the use of the automatic transmitter is extending in cable service, whilst on the Continent and in America the advantages of the Wheatstone automatic are being gradually recognized, as the increase of matter to be transmitted over existing landlines causes a demand for accelerated methods. The use of alternating currents of a fairly high frequency is also receiving attention. Professor Rowland has invented a multiplex typewriter working with alternate currents. The substitution of delicate optical receivers, working by photography for the purpose of enabling more rapid signals to be received, for the relays and recorders previously used, opens out a further field. Just as the limit at which the hand can send is surpassed by the automatic sender, so the speed at which the eye can read the visible motion is surpassed by that of the photographic receiver. In this connection the recent suggestions, on the one hand, of Squier and Crehore, and, on the other, of Pollak and Virág, demand careful attention. The experiments of the latter between Buda-Pesth and Berlin appear to have come as a surprise to many continental electricians not previously conversant with the Wheatstone automatic transmitter, while the success that they have obtained in sending words, at the rate of 1,300 to 1,500 words per minute, over a landline of 475 miles long, once more raises the familiar question whether a mile or two of subterranean cable inserted in the line would not have effectually barred the transmission and reduced it to ordinary rates. It is interesting to note that in their experiments success was largely due to the use at each end of the line of an inductive shunt, a device advocated so strongly for cables by our late past president, Mr. Willoughby Smith.

When we turn to the question whether such rapid methods of signaling will prove of any use on subterranean or submarine cables, we are still confronted by the old difficulty that no improvements whatever in apparatus at the ends of the cable will get rid of the sluggishness inherent in the cable itself, if constructed upon the traditional patterns. The suggestion which I advocated in 1893, of accelerating the speed of signaling by attacking the problem in the middle instead of tinkering at the ends, has not yet borne fruit. My suggestion to construct cables with a series of self-inductive, artificial leaks of high resistance distributed all along its length to combat its distributive capacity appears to be too radical to be acceptable to the cable authorities. But it is self-evident that whatever good an inductive shunt (or artificial "leak") at the end of a cable will do in getting rid of the static charges, an inductive shunt (or artificial inductive "leak") at the middle will do just twice as much. Why, then, should the suggestion to utilize this known property at one or more points along the length of the cable not be put to an experimental trial?

The competition of electricity with gas as a means of illumination has been rendered very severe by the improvements introduced during recent years in incandescent gas lighting. The discovery of the properties of the rare earths in giving an augmented illumination—the result of a purely scientific research—was the foundation of the invention of the Welsbach mantle. It is singular that the very same properties were not turned to account in electric illumination before the invention by Nernst of the lamp which bears his name; a lamp for the commercial introduction of which electrical engineers are still waiting expectantly. Meantime a far more important factor in the economic struggle remains in a possible reduction of the high prime cost of electric wiring of buildings. Could electric house wiring be carried out as simply and as cheaply as the putting in of gas pipes an enormous advance might be confidently expected. But so long as our station engineers and our fire insurance inspectors insist on having both wires fully insulated, and do not allow an uninsulated or a semi-insulated return conductor, so long will this advance be delayed. With the introduction of armored conduits for interior wiring, surely the prejudice which requires a double insulation will disappear.

In the public distribution of electric energy for lighting and power the necessities of economic working are effecting a slow but sure revolution. The methods that were in vogue at the date when the Electric Lighting Act of 1888 made electric distribution in this country commercially possible are being superseded. Larger generating units are being used in our stations. Larger areas of supply and fewer generating centres in an area are a necessity of the time. From the row of little bipolar dynamos, each with its own small high-speed engine—a sight so familiar in the older lighting stations of this country—we are gradually passing to the use of large multipolar machines coupled to larger and more economical steam engines. Ten years ago a distribution at six miles from the generating station was looked upon askance by many electrical engineers. To-day it is recognized that the secret of economical work is to generate on the large scale—"in bulk," as the phrase goes—and to distribute over large areas at an appropriately high voltage. Whether the prime source of power be hydraulic or thermal, the problems of economic distribution are essentially identical. Two of the most recent examples, both of water-power stations, must suffice. At the Kanderwerke, at Spiez, a pressure of 4,000 volts suffices for the distribution of current for lighting and power within a radius of six miles; but for the 30-mile distribution from the same station, to supply the city of Berne and the Burgdorf–Thun Railway, a 16,000-volt pressure is adopted. The city of Milan, which is lit by power from the hydraulic station at Paderno, 24 miles distant, receives its currents at 13,500 volts. When electric energy is thus generated and distributed on the larger scale, the time-honored methods suitable for parochial areas must give way to newer ones of greater economy. Continuous-current generators and motors are unsuitable for operation in such wise at economical voltages. The great superiority of alternating currents asserts itself here uncontested. And with the greater economy of copper that is afforded, in the transmission at a given superior limit of voltage, by the use of three-phase currents, commercial considerations of the most elementary order decree that the fittest shall survive. It was, doubtless, in its time a great advance when the late Dr. Hopkinson in this country, and independently Mr. Edison in America, introduced the "three-wire" system, in which by the employment of a central or neutral wire three copper conductors were made to suffice where four conductors had previously been needed. The obvious economy of using one neutral wire instead of two separate return conductors was sufficient to secure its rapid adoption. But with the introduction of the three-phase distribution we may now have three wires doing the work of six, each wire, when the circuits are equally loaded, serving as a return for the currents of the other two. In cases where, as in three-phase lighting, the three lines are not equally loaded, we may by adopting a Y-grouping with a neutral wire leading back to the common junction have one neutral wire serving in the place of three separate return conductors, thus carrying forward Dr. Hopkinson's idea to its logical extension. Experience in Heilbronn, in Strassburg, in Lyon, and a score of other places, proves that the fear formerly expressed as to difficulties in balancing the circuits is unfounded. In the light of such experience it is not premature to say that the use of the three-wire system with continuous currents is obsolete. Obsolete it is not, however, in the sense of being disused. Obsolete it is in the sense that a better and more economical method is known and is already largely in use. Of all the new lighting stations now under construction in middle Europe, quite two-thirds are designed for three-phase work. Even in Berlin, where the admirably engineered group of lighting stations on the continuous-current plan has been eminently successful, financially and technically, all extensions are being made on the three-phase plan; and in a few years the whole will probably have been converted to alternating currents.

While the continuous current is, of course, the only species admissible for electrolytic work with all its rapidly growing applications in the chemical in-

* Extracts from a presidential address before the Institution of Electrical Engineers.

dustries, the superiority of alternating currents for motive power and for all long-distance work is every day becoming apparent. Only a short time ago it was the fashion to decry alternating currents on the alleged ground that alternating current motors were not self-starting. That reflection might have had some weight 10 years ago. But the simple truth is that continuous currents will not work motors at all except toys of the old Barlow wheel type. Let him who doubts this statement ask himself what is the purpose of that costly organ, the commutator, which is an integral part of every so-called continuous-current motor. The sole function of a commutator is to commute a continuous current into an alternating one, and *vice versa*. If a continuous current will drive a motor, why go to the expense of putting into any motor a commutator to commute that current into an alternating one inside the machine? Moreover, the unnecessary commutator—for it is unnecessary if the currents are supplied to begin with as alternating currents—introduces the risks attendant upon the use of "brushes"—risks which have led the insurance companies to prescribe that all motors with commutators should be put in fireproof enclosures. Let it be once realized that the commutator is an unnecessary excrescence due to the supply of a particular kind of current which won't work a motor until commuted, and that, with the supply of the proper kind of current, no commutator is needed, and before long we shall see these restrictions withdrawn. A common grindstone is a thousand times more likely than a well-constructed modern commutatorless motor to cause an outbreak of fire. Yet no one prescribes fireproof enclosures around grindstones in any ordinary factory.

In the working of alternate-current generating stations, where parallel running of a number of generators is a necessity, the station engineer has always had before him the fear of a serious breakdown, should anything happen to one of the generators. If the field magnet of any one generator loses its magnetism through any failure of the exciting current, then all the other generators instantly pour an immense current through its armature, with dire disaster not only to it, but to the station as a whole. All manner of devices have been designed to combat this dread eventuality. Fuses and safety devices of every description, including automatic disconnecting gear warranted only to operate for currents in opposition of phase, are found not always to do their duty. Much discussion has arisen as to whether the excitation of alternators in parallel ought to be an excitation in parallel, or whether each alternator ought to be provided with a separate exciter on its own shaft. Even excitation in duplicate from two independent sources has been tried. It is satisfactory to note that a means has been discovered which will entirely remove this source of anxiety and render such accidents impossible in the future.

We are all familiar with the device of the embedded squirrel-cage construction introduced by Dobrowlsky and Brown nearly ten years ago into the so-called rotors of polyphase motors. In these motors the squirrel-cage structure revolves at a slightly lower speed than that of the revolving magnetic field; and it has long been known that if the same structure is mechanically caused to revolve at a speed slightly above synchronism, the machine becomes a generator, taking power to drive it. In brief, the induced eddy currents in the copper structure, when revolved above or below synchronism, magnetize it and make it act as a field magnet. Leblanc, adapting this device to the actual field magnets of alternators, has not only simplified the operation of synchronizing, but has given to the alternator the new and remarkable property that, on the failure of the excitation from the ordinary source, the automatic action of the eddy currents comes into play, and thereby entirely prevents the disastrous reactions which have been so much dreaded by station engineers. I regard this invention as one of the most important of recent years. It has been applied also to the 600-kilowatt alternators in the sector of the Champs Elysées in Paris.

Passing from the generation of current to its utilization for electric traction, the most notable evolution now in progress is that of the application of electric power to heavy railways. The application to street railroads—in other words, to mere tramways—has been an accomplished fact for ten years on the other side of the Atlantic, where there are now thousands of miles of electric tramways, mostly operated from overhead lines, from which the current is taken by a contact trolley wheel. If in this country the development of electric tramways has been slower, we have at least the advantage that our cities are not disfigured by networks of overhead trolley lines. No such objections hold good for rural districts, and slowly but surely both the industrial and agricultural districts of England are being furnished with electric intercommunication with its many attendant advantages. It may come as a surprise to many who think England behindhand in this respect, when they learn that while the total subscribed capital invested in this country in 1899 for public electric supply is about £17,800,000, no less than £20,800,000 is already invested in electric traction. Of the effect of the introduction of electric traction as a social and economic factor I have spoken elsewhere. There can be no question of the immense social benefit, particularly to the artisan population, afforded by this means. But the electrical engineer is now engaged on the still greater problem of operating heavy railways, and the development in this branch is being watched with keen interest. The two deep level railways in London, the City and South London Railway and the Waterloo and City Railway, both of which have amply justified their promoters, are shortly to be supplemented by the Central London Electric Railway, an undertaking of much greater magnitude, while several other similar schemes are either under construction or authorized. In the City and South London Railway the rolling stock is designed for separate electric locomotives, each drawing three passenger cars. The gauge is 4 feet 8½ inches. On the Waterloo and City line the trains consist each of four cars, of which the two end ones are fitted with motors, four motors on each terminal car, so that the train can be driven by either set of 4 motors. Each train can carry 204 passengers. The gauge is 4 feet 8½ inches, but, owing to the size of the tunnel, ordinary railway rolling stock could not be used. In the Central London line the gauge is also 4 feet 8½ inches. The locomotives, each with four gearless motors, weigh 35 tons each. Each will draw a train of seven cars, with a seating capacity of 336 persons per train. The total length, including sidings and cross-over lines, exceeds 8 miles of double track.

In all three of these railways the current is taken from a third rail on the surface, and the return circuit is through the ordinary rails, which, for this purpose, are bonded with copper bonds. All these lines are operated by continuous currents at 400 to 500 volts. In the case of the Central London line, part of the feeding is effected through rotatory converters which receive three-phase currents from step-down transformers.

In sharp contrast to these three London undertakings is the Burgdorf-Thun Railway in Switzerland, which was opened in July last. It is in every sense of the word a full-gauge railway. Not only is its rolling stock full gauge (the full gauge of Switzerland is 4 feet 8½ inches), but the railway admits of use by ordinary steam locomotives, drawing ordinary trains. The electric rolling stock is of two kinds—automobile cars carrying 66 passengers each, for use singly or in pairs, and locomotives of 300 horse-power each, for drawing trains of ordinary carriages or goods wagons. This railway is worked by alternating currents supplied in three phases, at 750 volts, the feeding being effected through stationary transformers at 16,000 volts. The currents are taken from two overhead conducting wires, the rails serving as the third conductor. The length of line thus electrically equipped is 40 kilometres, or 26 miles. The arrangements were designed, and the electrical equipment constructed, by Messrs. Brown, Boveri & Company, of Baden, who were the first to apply three-phase currents to traction. In the Lugano tramways as a commencement, then in the steep mountain light railways of Engelberg, of the Gornergrat, and lastly of the Jungfrau, they gained experience in this method, which now stands triumphantly demonstrated in its adaptability to the service of heavy lines. In the United States heavy railways have been, to a very limited extent, operated by electric locomotives. Some built for the Baltimore & Ohio Railroad, weighing about 90 tons, are employed to draw ordinary trains over a short line around part of the city of Baltimore. They work with continuous currents from overhead trolley lines.

There can be little doubt, however, that to Switzerland rather than to America we must look when desiring guidance as to the future development of this problem. All necessary data now exist for the exact working out of the necessary equipment of any given line, actual or projected. No experiments are needed to enable the constructor to proceed, so soon as it shall have been determined which kind of current is to be used.

TELEPHONE AND TELEGRAPH

It is said that the Calais, Folkestone and Boulogne steamboats will be fitted with a Marconi pole and Dover with ships' masts for the purpose of establishing wireless communication.

An ordinance was introduced in the Council recently to revoke the rights granted in Philadelphia to the Drawbaugh Telephone Company, saying it shows no disposition to enter into competition with the Bell Telephone Company.

The Pacific Coast Telephone companies made a net gain of 2,218 subscribers in December, and had in operation December 31, 64,538; net gain for the year 19,553, or over 43 per cent. San Francisco has in operation 16,817 subscribers.

The Farmers and Merchants' Telephone and Telegraph Company, with headquarters in New York city, was incorporated at Albany, N. Y., on December 30, with a capital of $100,000. The directors are George Sheppard, of Pittsburgh; George W. Beers, of Fort Wayne, Ind.; E. M. Higgins and J. G. Kaelber, of Rochester; Titus Sheard, of Little Falls; John H. Farrell, of Albany; E. F. Murray, of Troy, and R. E. Drake and G. W. Pulver, of Syracuse.

Meadville, Pa., will soon have a telephone war in earnest. The Bell Company has served the city several years and a rival, the Meadville Telephone Company, will soon be ready for business. The Bell Company had 401 subscribers, prior to the advent of the new company which has succeeded in securing 290 of the Bell subscribers and has also made contracts with over 200 people who have never as yet had telephones in their houses or business places. The new rate will be $24 per year. The Bell Company rate has been $36 per year, but the Bell rate will be reduced to a figure lower than anything yet announced, it is said.

The Telephone, Telegraph and Cable Company, of Eastern New York, was incorporated recently by the Secretary of State to operate lines throughout New York state, and especially between cities, villages and towns in the counties of Suffolk, Nassau, Queens, Kings, Westchester, Putnam, Dutchess, Columbia, Rensselaer, Saratoga, Washington, Warren, Essex, Clinton, Franklin, Schenectady, Albany, Greene, Ulster, Orange, Rockland, Richmond and New York. The capital is $10,000, and the directors are William H. Eckert, Walter W. Perkins, Arthur Phillips, William S. Eckert and Frank B. Ball, of New York city, and George W. Snyder and J. B. Stauffer, of Philadelphia.

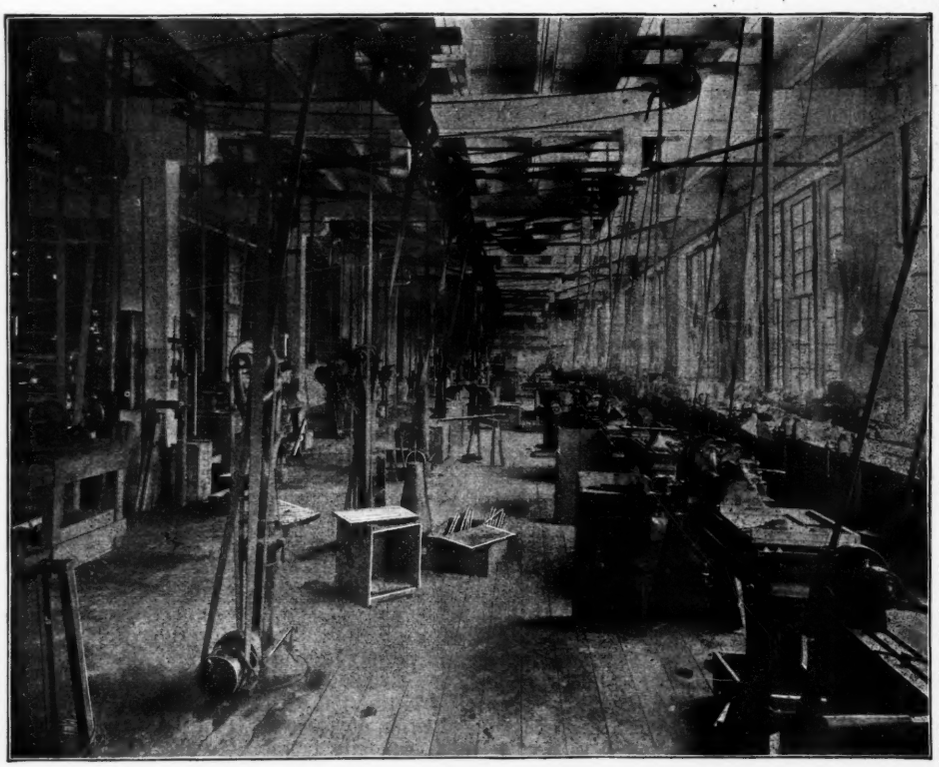


FIG. 1. A RHEOSTAT FACTORY.

President John I. Sabin of the Pacific States Telephone companies issues a circular to the effect that the Sunset Telephone and Telegraph Company (Bell Telephone Company) has purchased the property of the Peoples' Telephone Company, of San Jose, Cal., an independent company. The original stockholders in the opposition telephone company in San Jose are stated to have lost every dollar they put into the business, the company having been sold out for debt and the new stockholders who purchased the old company for the amount of its outstanding indebtedness have now sold out to the Sunset Company for a sum less than that for which the property was knocked down under the hammer.

The Erie Telegraph and Telephone Company has declared regular quarterly dividend No. 65 of 1¼ per cent; the Wisconsin Telephone Company dividend No. 70 of 1¾ per cent; and the Michigan Telephone dividend No. 62, of 1¼ per cent. The directors of the Erie telephone system have fixed permanent dates for future payments of quarterly dividends, namely: The second Monday of January, April, July and October, to stockholders of record at the close of business on the last day of December, March, June and September. The stock books close on the last mentioned days and open on the day the dividend is paid. The action of the Erie telephone board of management in fixing the second Monday of January as the date of payment of the quarterly dividend of the several companies makes the payment five weeks earlier than heretofore.

An interesting contribution to what may be called the law of delayed telegrams has recently been made by the Court of Appeals of Kansas, Northern Department, in the case of McCall *vs.* the Western Union Telegraph Company. McCall, suffering from a sudden rupture, telegraphed at 11 o'clock one night for a doctor living in a town 11 miles distant. The message was received at the doctor's town at 11.05 the same night, but was not delivered until seven o'clock the next morning. McCall suffered all night, and was operated on in the morning. The company admitted its negligence, but claimed that McCall could recover only 25 cents, the cost of the telegram. The jury gave him $1,400 damages for the operation necessitated by the delay, his permanent disability, his loss of time, and his intense suffering for eight hours until the doctor arrived. The Court of Appeals, in upholding this verdict, called especial attention to the last item as an element of recovery.

A Rheostat Factory.

Very few people have any idea of the magnitude of the rheostat business. The illustrations shown herewith give an excellent idea of the process of manufacture and the machinery employed in the construction of these instruments. The plan shown is that of the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis. In taking the photographs for the illustrations it was considered best to seize a moment when the machinery was idle and the men out of the factory to avoid the bad effect of floor vibration upon the camera. Fig. 1 shows one side of the first floor of the factory where controllers for elevators, cranes and other controllers for the larger sizes of motors are built. Fig. 2 shows a portion of the second floor devoted exclusively to the manufacture of standard motor-starters and speed regulators of various types. Fig. 3 gives an excellent idea of a portion of another floor where special apparatus is made and where also field rheostats for motors and dynamos are constructed. In addition to the departments shown in the illustrations are those for making printing-press controllers, regulators for organ-blowing motors and for numerous other varieties of rheostats. Since the organization of this company it has grown steadily in the scope of its operations, and was recently obliged to move on this account from its old quarters in Chicago to the newer and larger factory shown in the illustration, situated in the city of Milwaukee. It is expected that within a year another building will have to be erected on adjacent property to accommodate the growing business of the company.

FIG. 2.—A RHEOSTAT FACTORY.

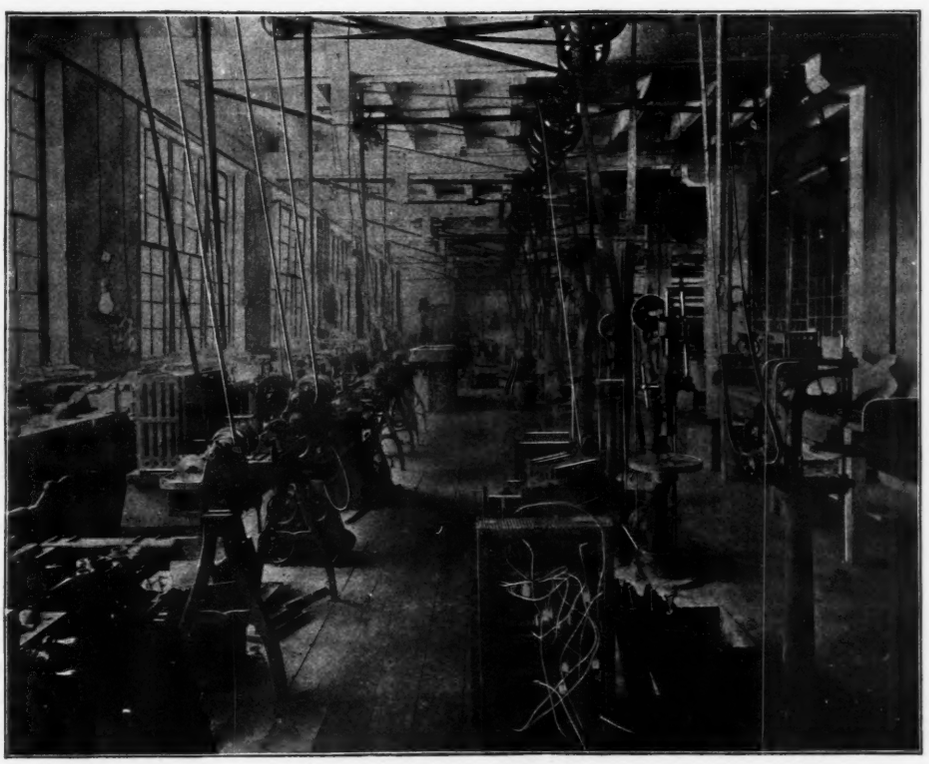


FIG. 3.—A RHEOSTAT FACTORY.

In the incorporation at Denton, Md., of the Eastern Shore Telegraph and Telephone Company is a scheme for the consolidation of all the telephone lines on the Maryland and Delaware Peninsula. The capital stock of the new company is $100,000, and the incorporators are Thomas L. Day, William H. Dewees, James A. Trazzare, Fred R. Owens and Jacob E. Ellwanger. The stock is divided into 4,000 shares at $25 each, all of which are taken. The following officers were elected: Harry A. Richardson, president; Thomas L. Day, vice-president; Fred R. Owens, secretary; Dupont Walker, treasurer. The directors are: George W. Woolford, of Cambridge; William R. Martin, of Easton; Thomas L. Day, of Ridgely; William J. Price, Jr., of Centreville; Fred R. Owens, of Denton; Harry A. Richardson, William H. Baker and Dupont Walker, of Dover. It is proposed to consolidate the Maryland Eastern Shore lines with the Diamond State Company of which Mr. Richardson is also president. Substantiation of this is found in the fact that the directory is composed of men interested in the different telephone companies of the shore.

AUTOMOBILES AND ELECTRIC-POWER PLANTS IN SWEDEN.

BY UNITED STATES CONSUL ROBERT S. BERGH, GOTHENBURG, SWEDEN.

Many business men here think that the import of motor carriages into Sweden, if once properly started, will be considerable, provided they can be made durable, neat in appearance, safe and easy to handle, and not too expensive. Cab owners, especially in Stockholm, are considering the advisability of purchasing motor carriages, and a short time ago they sent experts to Berlin to study and examine motor cabs manufactured in Germany. The report they made on their return was not altogether favorable. They said that automobiles which in catalogues seemed to be ideals of perfection, in reality did not come up to expectations.

The chief objection to the motor cabs, with accumulators or storage batteries, was that they could not make sharp enough turns. The cabs were built with the batteries placed close to the back wheels. The steering power of the front wheels was so small that the carriages could turn only in very large curves, making them unfit for use on narrow streets. Another inconvenience was that as soon as the cabs got on a road covered with a layer of sand an inch thick they stopped helplessly.

Besides these inconveniences, common to French and German motor cabs alike, it was said that few of the carriages exhibited were of the type desired—that is, with room for from two to four passengers. Hunting wagons, motor cycles, delivery wagons, etc., for sportsmen and business houses, were plentiful; but cabs were fewer and, as a rule, clumsy in appearance. A German manufacturer promised, however, to remedy the faults mentioned; but it is not yet generally known whether the prospective purchasers and the manufacturers can agree on terms. Manufacturers of motor carriages usually demand one-fourth of the price for thirty days' trial; while the cab owners in question desire free trial before purchase, because they are unwilling to buy such expensive machines without being sure that they are practically useful.

At present, there is only a petroleum-motor carriage and a light motor cycle in Gothenburg, both of French manufacture. I believe there is an American motor carriage in Stockholm; but American manufacturers ought to pay attention, also, to the markets in the other cities of this Kingdom, especially Gothenburg and Malmo. It would be of great advantage for American firms to be represented here at once.

Another thing of importance is electrical machinery in general, which will be in great demand as soon as the people have fully learned the value of their numerous waterfalls. A large electric-power plant will soon be built at Trollhattan; electric railways and tramways are being planned for Gothenburg, Lund, Bjerrod and Jonkoping. In this line, as in everything else, the Germans are always watchful; they pay close attention to details, and, if necessary, send experts here to study plans, etc., whereby they greatly increase their chances to introduce machinery. If it is not practical for Americans to do likewise, they could possibly employ active agents to represent them here.

Electric-motor carriages are preferred for city traffic. Those with benzine motors are said to be noisy and to emit offensive gases.

A New Electrolytic Process of Manufacturing Chemicals.

For some months past there has been an increasing activity in the chemical trade of this district—the largest and most important of its kind in Great Britain—and quite recently an added impetus has been given by the establishment of works using a new electrolytic process, writes U. S. Consul James Boyle, from Liverpool, England. Up to a few years ago, the chemical trade of this district was exceptionally prosperous; but now it has to meet German competition, and since the going into active operation of the present tariff, the exportations to the United States have tremendously decreased. During the fiscal year ended June 30, 1893, there were exported to the United States from this district alone chemicals to the value of $9,507,269. During the fiscal year ended June 30, 1899, the value was only $1,982,536. The trade appears to recognize that it can never recover the American market—at least not to the extent heretofore existing. The endeavor is to create new markets and meet competition by more economical methods of manufacture.

There has just been started at Farnworth, near Liverpool, a new process of separating chlorine and sodium by the direct decomposition of salt by electrolysis, without the introduction of any other ingredient. It is called the Hargreaves-Bird process. The Liverpool *Post* gives the following explanation of the method:

"Salt is submitted to a suitable current of electricity, and both the substances are produced unmixed and pure. The salt used is in its cheapest form, being that of brine pumped up from its native bed, the salt of which—delivered into the actual apparatus of the factory—costs no more than about six cents per ton, as against $1.70, the usual price for the rough salt used in the older alkali works. The apparatus, or cell, in which this is effected is a narrow tank, the walls of which are porous. Brine is pumped into it, and on the passage of electricity a solution of soda flows slowly down from the outside of these wet walls, yielding at once soda crystals; while the chlorine in like automatic manner passes away for the production of bleaching powder, chlorate of potash, or such other chlorine compounds as may be required. No raging furnace, no sulphur kilns, nor the noxious fumes rising from such are present. No waste materials are produced, unless as such be reckoned the ashes from under the steam boilers which produce the motive power for the generation of the electric current. Even the smoke from the boiler fires and the waste steam from the engine are used in carbonating and dissolving the soda thus formed. In the actual production scarcely any hand labor is required. All moves on in silent regularity, and it is only in the necessary handling and packing up of the materials produced that labor comes in.

"One distinction of the cell is the peculiar diaphragm used. It is a sheet of asbestos composition, non-porous in the ordinary sense of the term, but when forming the walls of the cell, the contents of which are electrically excited, it allows molecules of sodium hydroxide to pass, but very little sodium chloride."

It is claimed that the above process is much more economical and simple than the former, including the rival electrolytic methods. It is stated that one difference between the Hargreaves-Bird process and the Kastner-Keller process (which has been in use in this district for some time) is that mercury is used in the latter process, but not in the former. Large sums of money have been spent in experiments with different electrolytic methods with varying success, and it is too early yet to say whether the new process will meet expectations. Speaking generally, however, the chemical trade of this district is now in a flourishing condition, and orders during the last month have been exceptionally large—mostly, however, for home consumption. Still, trade is not as good as it was ten years ago. Since the great decrease in shipments to the United States, continental orders have largely increased, in spite of German competition. Most of the new orders have been from Germany, Russia and France. Present prospects are good.

An Electrical Specialty Manufacturing Plant.

The specialization of electrical manufacturers has resulted in the establishment of many factories for the making of the smaller parts of electrical installations, and in these the full benefits to be secured from the concentration of attention on small detail are obtained. The weakness of many electrical systems is in their auxiliaries, such as switches, fuses, rheostats, etc., the importance of these elements not being always recognized.

The illustrations shown herewith represent interior views in a factory equipped with highly modern tools for the manufacture of electrical specialties and auxiliaries—the works of the Falcon Electric Manufacturing Company, in New York city. Here are constructed fan motors, arc lamps, switchboards and switches, receptacles, plugs, etc. Many of these articles are of ingenious design, as, for example, a radial ampere-meter switch, permitting one ampere-meter to be used on several circuits.

The fan motors are of the direct-current enclosed desk type, having radial carbon brushes held in ingenious and well insulated brush-holders of tubular form. Their lubricating arrangements are unusually perfect. A large line of knife switches is also manufactured. Figs. 1 and 2 show views in the main machine shop of the company, where a large number of milling machines, turret lathes, screw machines and other tools are turning out switchboard parts. Fig. 3 shows a switchboard being assembled.

The officers of the Falcon company are Messrs. Eduard Leissner, president; H. O. Swoboda (to whom is due the design of most of the specialties manufactured), vice-president and general manager, and L. E. Frorup, secretary and treasurer.

Municipal Electric Light Plant Finance.

Bay City, Mich., has a municipal electric light plant. This is what a newspaper published in Bay City has to say about it:

"Under the present rates in this city for electric lighting the merchants and householders who use electric lights are paying the entire expense of lighting the city streets.

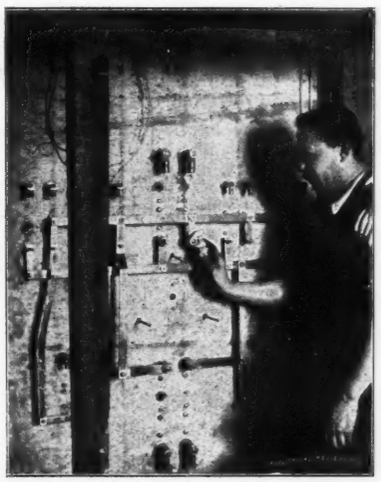


FIG. 3.—AN ELECTRICAL SPECIALTY FACTORY—FINISHING A SWITCHBOARD.

"With the rates in force the plant is self-sustaining, and the men who own property are charged nothing in the way of taxes for street lighting purposes, whereas, before the city put in its own plant, the cost was in the neighborhood of $5,000 per year.

"The private users of the lights are not making any kick on the rates charged them, but they feel that another year some charge for street lighting, say $30 or $40 per light per year, should be assessed against the city at large.

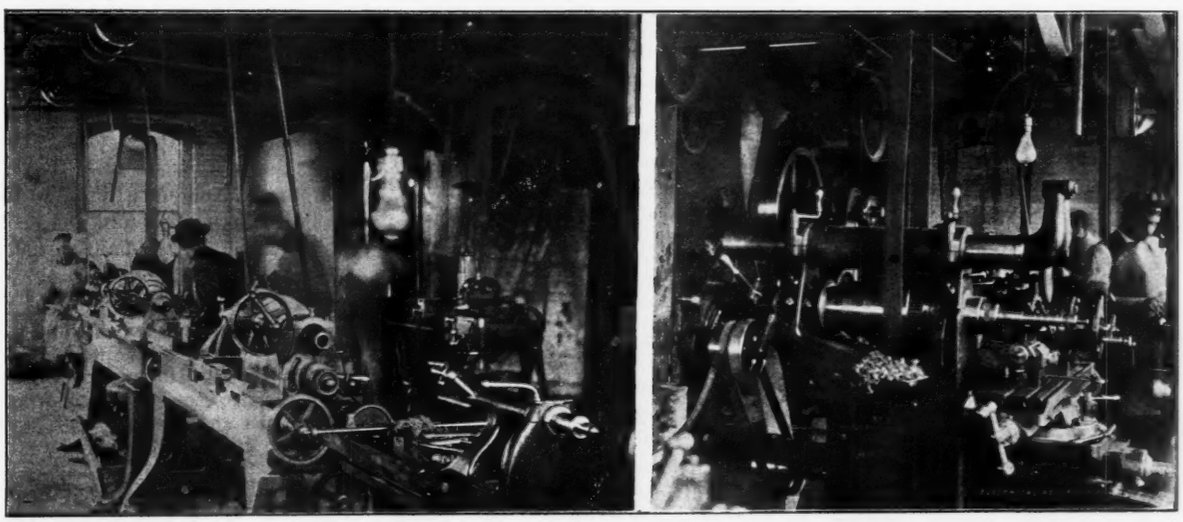
LITERATURE

Annuaire Pour l'An 1900. Publié par le Bureau des Longitudes. Paris. Gauthier-Villars. Supplied by the ELECTRICAL REVIEW at 75 cents.

The well-known and valuable "Annuaire" contains this year, in addition to the usual tabular matter, a paper by M. Cornu on electric generators, and a note by M. Lippmann on the new gases in the atmosphere.

A new magazine, the *International Monthly*, published by the Macmillan Company, New York and London, has just made its appearance. The contents consist of essays by authors of high reputation in various departments of contemporary thought, and range over such subjects as history, the industrial arts, the several branches of science, and even comparative religion. The advisory board of editors comprises, among its members, some of the most famous and advanced thinkers of the day. The editorial management is in the hands of Mr. Frederick A. Richardson. The first number contains articles by Professor John Trowbridge, Professor N. S. Shaler and M. Rod, the great French critic. The ELECTRICAL REVIEW extends its best wishes to the new magazine, with the hope that its success may be commensurate with its very great merits.

A mortgage for $200,000 to secure bonds given by the Inland Traction Company to the Lehigh Valley Trust and Safe Deposit Company, of Allentown, Pa., was recorded a few day ago. John H. Pascoe is president of the Traction Company, and T. J. Crilly, secretary. The mortgage is a lien on all the property of the mortgagor in Lehigh, Bucks and Montgomery counties.



FIGS. 1 AND 2.—AN ELECTRICAL SPECIALTY MANUFACTURING PLANT—TWO VIEWS IN THE MACHINE SHOP.

Electricity Supply From Central Stations.

Mr. J. W. Lieb, Jr., who delivered an address before the New York Electrical Society, under the above head, on December 21, 1899, opened his remarks by a reference to the extent and character of the territory included within the limits of Manhattan Island, pointing out that this field presents nearly all of the varying conditions of electricity supply covering many of the problems connected with the generation and distribution of electricity for lighting and power purposes.

After a brief review of the history of the electric lighting industry previous to the starting of the old Pearl street station of the Edison Company, an interesting picture was presented of that pioneer lighting station, including reminiscences of the early difficulties encountered in the construction and operation of the station machinery and how they were successfully overcome. Some interesting maps were shown, including maps of the original underground system, diagrams illustrating a house-to-house canvass made by Mr. Edison, showing all the gaslight and power users in the district, and a map on which future distributing stations are laid out, covering all the territory up to Central Park, within which 38 distributing centres were located.

Series of curves were presented, showing the development of the business of the New York Edison Company from '83 to date, including curves of income, load, connected installations, etc., etc.

The loads carried by the several stations connected to the system were shown by varicolored curves, and explanations were given of the character of the business in each district as reflected in the peculiarities in the forms of the curves. Parallel curves, exhibiting the variations from month to month and from year to year, formed a graphic indication of the effect of the season and the variations in the hours of the rising and setting of the sun.

A sectional plan was shown of the water-side station now being constructed between Thirty-eighth and Thirty-ninth streets and the East River, by the New York Gas and Electric Light, Heat and Power Company.

The equipment of this station, covering a plot 190 by 273 feet, was described in detail, and data was given of the efficiency which it is expected to obtain from the engines, generators, etc The complete plant will consist of sixteen three-crank compound-condensing engines, 75 revolutions per minute, and developing each 5,200 indicated horse-power at most economical cut-off, and nearly 10,000 horse-power at maximum power. Each engine will be direct-connected to a three-phase generator, operating at 6,600 volts and rated at 3,500 kilowatts, but capable of operating with a load of 4,500 kilowatts for three hours.

Fifty-six boilers, each of 6,400 square feet of heating surface, will furnish the steam supply, and it is proposed to equip the boilers with superheaters in addition to the usual complement of automatic stokers, feed-water heaters, feed pumps, etc. The products of combustion will be discharged into four steel stacks, each 19 feet in diameter and 196 feet high above the grates, supplemented, when necessary, by forced draught from fan blowers.

A map of the extensive underground system supplied with current from the Edison Company and by the companies associated with it, under the administration of the New York Gas and Electric Light, Heat and Power Company, was shown, for which the water-side station is to furnish the main current supply.

A number of rotary converter stations now in course of construction at Horatio street, West 84th street, East 121st street and West 124th street, will be equipped with rotary converters and storage batteries, permitting of an extension of the direct-current underground system into new and hitherto unoccupied territory and together with rotary converter equipments at several of the present generating stations, will afford at once a considerable outlet for the high-tension three-phase current generated at the water-side station, enabling also some of the less economical generating apparatus to be put out of commission, and to be used during only a few months of the year on the peak of the load. The speaker then briefly touched on some details in the method of distribution in future of series arc lighting, rectifiers, etc., etc., which the lateness of the hour made it impossible to consider at length.

The Erie Telegraph and Telephone Company has declared the regular quarterly dividend No. 65 of 1¼ per cent; Wisconsin Telephone Company dividend No. 70 of 1¾ per cent, and the Michigan Telephone Company dividend No. 62 of 1¼ per cent. The Erie dividend is payable January 8 to stock of record December 30. Transfer books will be closed December 30 and reopened January 8. The directors of the Erie Telephone system have fixed permanent dates for future payments of quarterly dividends, namely: The second Monday of January, April, July and October, to stockholders of record at the close of business on the last day of December, March, June and September. The stock books close on the last-mentioned days and open on the day the dividend is paid.

Boston and Portsmouth, N. H., Connected by Trolley Lines.

The action of the stockholders of the Portsmouth & Dover Railroad at a recent meeting, in granting to the Exeter, Hampton & Amesbury Electric Street Railway the right to build its line over a part of the road in North Hampton, from Little Boar's Head, which is comprised in the Portsmouth & Dover Railroad charter, so as to connect with the Portsmouth Road, which will be built to this point, was a matter of considerable importance in electric railroad circles, as it means the connection of Portsmouth and Boston by electric road, and that before the advent of another Summer season. As it is now, the Portsmouth Road, which is under control of the Portsmouth & Dover Railroad, is in operation as far as Rye Centre, and thence there is a break of about six miles to the next road, or the Exeter, Hampton & Amesbury Street Railway, which runs nearly half-way across the Ocean road from Hampton to Little Boar's Head, or as far as its charter permits.

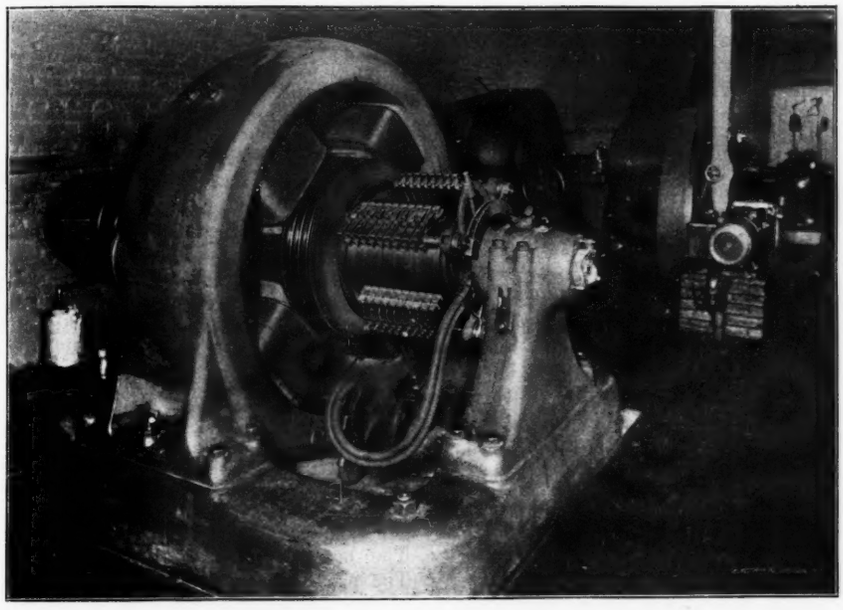
The location to make this connection has been granted to the Portsmouth & Dover Railroad, and the road has already been surveyed and the ties and tracks distributed over the route in preparation for the building of the road in the early Spring. The route will run along the main road from Rye Centre to a point near the house of the Hon. Emmons B. Philbrick, at Rye Beach, from which it will leave the road and go across the fields and marsh a distance of half a mile, coming out on the Depot road in North Hampton, near the residence of Ambrose Batchelder, and thence to a point near the old fish houses on the Ocean road. This will leave the section between the Exeter, Hampton & Amesbury Road, a distance of half a mile, to be built, and it is this section which will be built by the latter road, as mentioned above.

This connection made, the road will be complete from Portsmouth to Boston, the route lying through Hampton to Seabrook on the Exeter, Hampton & Amesbury Road, then to Amesbury, and from there to Lawrence and Lowell, then to Boston by a more direct route.

It has been announced that the Mount Vernon, N. Y., Telephone and Messenger Company has been acquired by the Maloney syndicate, of New York, which recently purchased the local plant and franchises in New Rochelle, Yonkers, White Plains and Mamaroneck. The new company, it is said, will begin at once to construct its lines in Westchester County, in order that they may be connected with the parent plant to be built in New York. Tolls on long-distance calls will then be reduced.

An Interesting Application of Niagara Power.

An interesting application of the power of Niagara Falls is found at the steel and malleable iron plant of Messrs. Pratt & Letchworth, at Black Rock, near Buffalo. The works of this concern cover 23 acres, of which 12 are under roofs. The molten metal is handled by electric cranes of great size and power, operated on a 220-volt direct-current furnished from the rotary converter described below. Current is received at the plant from the Niagara Falls transmission line at a pressure of 11,000 volts, three-phase. The first



A Rotary Converter Acting as a Synchronous Motor.

transformation for distribution around the shop is 2,200 volts. A switchboard, having oil-enclosed switches, distributes this to three stationary step-down transformers which there reduces it to 170 volts. The novel and ingenious method of working rotary converters employed in this plant is shown in the accompanying illustration.

This rotary receives the alternating current and is operated by it as a motor at about 750 revolutions per minute. It furnishes to the line shafting about 100 horse-power, working as a synchronous motor. From the commutator of the same machine 800 amperes at 250 volts, direct current, is supplied to the shop motors. This machine takes the place of a main steam engine which formerly operated the plant and also of the electric generators which furnished current for lighting the shops.

Leadville, Colorado, Wants Electric Power.

The scarcity of coal in the Leadville district has forced upon the miners of that camp the importance of electric power for a district that, through existing transportation conditions, is liable to a coal famine at any time. The results of a coal famine in Leadville at any time would be disastrous, as it would mean the suspension of pumping operations in the downtown district. It would be doubly so in the Winter season.

Election of Directors of the Brooklyn Electric Lighting Company.

At the meeting of the stockholders of the Kings County Electric Light and Power Company, held on Monday, January 8, the following directors were elected to serve during the ensuing year: A. N. Brady, W. Ferguson, A. M. Young, H. J. Grant, Seth L. Keeney, Felix Campbell, T. S. Williams, Wm. F. Sheehan, B. Gallagher, H. C. Duval, Charles Cooper, Wm. Berri, Thos. E. Murray.

The affairs of the company were found to be in a highly prosperous condition, and almost the entire stock of the company was represented at the meeting, which was quite harmonious.

A meeting of the directors will be held on Friday of this week to elect officers.

This company has absorbed all the electric lighting companies of Brooklyn, and its plant is considered to-day one of the most modern installations in the United States.

The danger of a failure of the water supply at Hartford, Ct., has thoroughly aroused public-spirited citizens, and there have been numerous offers of assistance. The proposal of the Hartford Street Railway Company to furnish a 200-horse-power motor free was accepted, and it is hoped the pump may be working again within a week, for which length of time it is thought the reservoirs may hold out.

Wall Street and the Electrical Stock Market.

Wall street began the year with its eyes upon the Anglo-Boer war which apparently is at last receiving the amount of consideration due it. The money markets of the world have become seriously deranged, chiefly on account of this war. While, for the current week in Wall street, the market tended toward an improvement, it was checked by the sudden selling for foreign, and especially German, account. It is estimated that more than one hundred thousand shares of stock will ultimately be returned to this side of the water. As far as domestic trade and financial conditions are concerned the state of affairs is satisfactory. Except for the uncertainties involved in the Anglo-Boer war there is little to disturb the immediate situation.

On the New York Stock Exchange General Electric closed the week at 121½ bid and 124 asked, a gain of ½ point for the week. Metropolitan Street Railway, of New York, closed at 175¼ bid and 175½ asked, a loss of ⅜ of a point for the week. Third Avenue Railroad, of New York, closed at 133 bid and 135 asked, a gain of 3 points for the week. Brooklyn Rapid Transit closed at 72 bid and 72¼ asked, a gain of ⅛ of a point for the week. Manhattan Railway, of New York, closed at 95⅛ bid and 95¼ asked, a loss of 1¾ points for the week.

On the Boston exchange American Bell Telephone closed at 341 bid and 343 asked, showing no change in the bid price for the week. Erie Telephone closed at 107 bid and 107½ asked, a gain of 6½ points for the week.

On the Philadelphia exchange Electric Storage Battery closed at 76 bid and no asked price, showing a loss of 4 points in the bid price for the week. Union Traction closed at 39 bid and 39¼ asked, a gain of ¾ of a point for the week. Electric Company of America closed at 13 bid and 13¼ asked, a loss of ¼ point for the week.

On the curb or outside market in New York Electric Vehicle closed at 65 bid and 70 asked. Electric Boat closed at 24 bid and 26 asked. Electric Axle closed at 5 bid and 5½ asked.

Wall Street, January 6.

The Phœnix, Ariz., Street Railway was sold at receiver's sale recently to the Phœnix Railway Company for $33,342. Definitely, the personnel of the new company is not known, but it is stated that it is composed entirely of California people. It is thought that General Sherman is one and Walter Gillellen another. B. N. Pratt, the new company's representative, said that, within the next week, the plans and identity of the new company would be announced.

ELECTRIC RAILWAYS

Thirty-two cars and a car barn of the Chicago Street Railway Company, at Hammond, Ind., were destroyed by fire January 9, causing a loss of about $130,000. Motor cars, sweepers, sprinklers, and a large quantity of apparatus were reduced to ashes.

The car barns and repair shops of the Greensburg, Pittsburgh & Jeanette, Pa., electric street-car line were burned recently. Seven cars, embracing the entire rolling stock of the company, and valuable machinery were destroyed, entailing a loss probably of $50,000. The road has been fatally crippled. The cause of the fire is not positively known. A night watchman was on duty, but he can not explain how the fire started.

The New York, New Haven & Hartford Railroad Company will soon commence the erection of a mammoth storage battery at Berlin, that is intended to be operated in connection with its current from the Berlin power house, so that it will be possible to maintain the schedule on the Bristol end of the system. At present the service is not satisfactory at all times, for, when the travel is heavy, the big cars drag and the schedule gets disarranged. During every hour of the day that the current is turned on the third rail there is a half-hour that the cars are not using any of it.

The Milwaukee, Wis., Electric Light and Railway Company is selling four-cent tickets. These tickets are put up in packages, 25 for a dollar, 12 for 50 cents and six for 25 cents. They can be used only from five to eight o'clock in the morning, and from five to seven in the evening. The company expects to increase its income by the gain of many patrons who now walk distances which they will not attempt when fares are lower. In the hours named the cars are generally well loaded, and a crowded car is worth more at four cents a head than a half empty one at five or even six cents.

Vice-Chancellor Reed, at Trenton, N. J., has decided that in the interest of public safety the West Jersey Traction Company shall construct an underground tunnel in crossing the West Jersey & Seashore Railroad tracks at Haddenfield. The Vice-Chancellor said no grade crossing should be allowed at the place. The tunnel can be constructed for $12,653. The railroad runs daily 72 trains at that point and oftentimes many special trains. The Vice-Chancellor says: "So long as men are careless, as they always will be, the instances of collision in grade crossings will engage the attention of the courts and create the wish that grade crossings may be abolished."

OUR NEW YEAR DOUBLE NUMBER.

"MANY SPECIAL ILLUSTRATED ARTICLES."

[*New York Tribune.*]

The ELECTRICAL REVIEW publishes a New Year's double number, consisting of 82 pages, containing many special illustrated articles, written by well-known experts, and a review of electrical progress in America in 1899.

GLAD TO BE IN IT.

TO THE EDITOR OF ELECTRICAL REVIEW:

We congratulate you on the fine appearance of your issue of January 3, and are very glad that we took a page in it.

American-Ball Engine Company,
F. H. BALL,
General Manager.

Bound Brook, N. J., January 9, 1900.

"THE BEST."

H. C. Cushing: "It is the best you have ever done."

"SET A STANDARD"

W. F. Osborne: "You have set a standard that will be hard to equal."

"MORE CONVENIENT."

[*New York Commercial Advertiser*]

The ELECTRICAL REVIEW, with the new year, appears in a new dress, and is changed in several ways. There is a new color of cover and a new arrangement of reading columns, all contributing to a more convenient and presentable publication.

Henry D. Lyman: "I congratulate you on the Double Number that opens the campaign of 1900"

Important Electric Lighting Changes in Kansas City.

A dispatch from Kansas City, Mo., states that by the action of the directors of the Edison Electric Light and Power Company and the Kansas City Electric Light Company, the electric lighting business of Kansas City has passed into the control of the Armours of Kansas City and Chicago, Robert Fleming of London, C. F. and W. H. Holmes of the Kansas City Metropolitan Street Railway Company, and other local business men.

The principal owner of the two companies was the United Gas Investment Association. That company has surrendered its control, and the heaviest individual stockholders, Winthrop Smith and W. N. Coler, Philadelphia and New York bankers, withdrew. It is stated that the investment is now over $1,000,000 and that half a million dollars more will be put into improving and extending the service and bringing it up to date.

ELECTRIC LIGHTING

The Lisbon, N. H., Electric Light Company and the Lisbon Power Company have been consolidated and a new company organized with a capital stock of $30,000.

The Hancock Electric Light and Power Company, which operates the light plant and the street railway at Findlay, O., will put in a big plant to furnish steam heat to Findlay residences and business blocks.

An accident at the power station of the United Electric Light and Power Company, at Twenty-ninth street, East River, New York, caused the electric lights in a large district of the city to go out for some twenty minutes Tuesday evening, January 9. This created much excitement at the theatres and hotels along Broadway.

At the annual meeting of stockholders of the Parsons, Pa., Electric Light Company, yesterday the following officers were elected for the year: E. F. Cooke, president; Liddon Flick, vice-president; C. C. Rhodes, treasurer and general manager; John D. Colvin, secretary; and the following directors: George W. Mitchell, Thomas Govier, W. U. Shaw, N. W. Reynolds, J. H. Kenney, and A. A. Sterling.

At the yearly meeting of the new Omaha, Neb., Thomson-Houston Electric Light Company, the following new officers were elected for the year: President, Fred A. Nash; vice-president, Henry W. Yates; general manager, H. W. McManigal. The board of directors was re-elected. The prominent changes in the personnel of the office force were due to the death of President Thomas L. Kimball and the resignation of General Manager W. S. White.

The electric light station at Peaks Island, Me., is to be entirely remodeled for service next season. In the past there have been two small dynamos and an engine to run them. These are to be taken out and a large machine with direct-coupled engine will take their place. This will do better service at a less cost in every way. There will be less fuel used, less expense for attendance and less lubrication necessary, while the output of lights will be greater than ever before.

Articles of incorporation of the Consolidated Light and Power Company, organized for the purpose of manufacturing gas, electric currents, and electric energy for light, heat, and traction work in all of the municipalities and counties in the State, were filed in the office of the County Clerk in San Francisco, lately. The capital stock is $500,000, of which $50 has been subscribed. The directors and subscribers are: Robert J. Davis, Ross, Marin County; E. M. Pease, Palo Alto; C. E. Green, San Mateo; A Poniatowski, San Francisco; and J. E. Green, San Francisco.

INDUSTRIAL NOTES

John T. McRoy, of Chicago and New York, manufacturer of vitrified clay conduits, has issued a calendar blotter for January, carrying an original verse appropriate to the season.

"Graphite" is the title of an interesting little publication issued by the Joseph Dixon Crucible Company, Jersey City, N. J. It gives pointers as to the numerous uses of graphite.

The Central Telephone and Electric Company, St. Louis, carries a large stock of standard telephone instruments, telephone parts, and, in fact, all telephone equipments, and has splendid facilities for western shipments.

The Western Telephone Construction Company will erect a new manufacturing plant at Winthrop Harbor, near Chicago, plans for which already have been prepared. It is expected the new plant will be ready for use by next May.

The Electric Appliance Company, of Chicago, announces that its factory, engaged in the manufacture of the Gutmann wattmetres, is now able, through its excellent facilities, to turn out these metres in quantities to fill all orders promptly. Users of this metre are invited to make a note of this.

The Hazard Manufacturing Company, Wilkes-Barre, Pa., whose New York office and warehouse are at 50 Dey street, has issued a new catalogue and price-list of its bare and insulated copper wires and cables. The catalogue contains some valuable tables, and may be had free for the asking.

The Okonite Company, New York, held its annual meeting last week and report a prosperous year during 1899, with a very brilliant outlook for 1900. This company's insulated wires and cables are known the world over and merit the high praise they receive from all branches of the electrical industry.

The Edison Manufacturing Company, 135 Fifth avenue, New York city, informs its customers that, owing to the very rapid and continued advance during the entire year in the cost of all raw material used in the construction of Edison-Lalande batteries and renewals, it is absolutely forced to withdraw present list prices and to issue a new price list, which may be had free on application.

Elmer G. Willyoung, 82 Fulton street, New York, has just issued a complete and valuable catalogue of electrical and scientific instruments and apparatus. The volume is elaborately prepared and should be acceptable to scientists. It is descriptive of electrical condensers of various kinds, galvanometers, testing sets, photometers, Wheatstone bridges, X-ray apparatus and other similar apparatus.

Frank H. Stewart & Company, 35 North Seventh street, Philadelphia, report an unusually busy season in electrical supplies. This company carries a full line of electrical specialties of every description. They have recently published three interesting catalogues, which they will send on application. These catalogues are printed separately, and cover telephony, electric lighting and household supplies.

The Tucker Electrical Construction Company announces its removal from its former offices at 14-20 Whitehall street, New York city, to 35 South William street and 31-33 Stone street. This company has been for many years in the electrical engineering and construction business in this city, having started in the Spring of 1887. It reports a large increase of business during the past year.

The Keystone Electrical Instrument Company, Philadelphia, Pa., has recently been successful in introducing its instruments in a large number of the most modern and carefully engineered electrical stations in the world. In fact, the general increasing adoption of "Keystone" instruments is sufficient indication to demonstrate the fact that this line of electrical measuring instruments is now accepted as a high standard by electrical engineers and electricians throughout the world.

The American Engine Company, Bound Brook, N. J., has introduced a new arrangement of pistons in the construction of the American-Ball duplex compound engine, so that no more valve gear is needed than in the simple engine and only one added piston. A saving in steam of fully 25 per cent may be depended upon, according to the company's statements, with all loads, without the condenser, and nearly double that amount when run condensing. This company furnishes complete electric plants, including engines, generators and motors of its own design and manufacture.

The Emerson Electric Manufacturing Company, St. Louis, Mo., has within the past few weeks published the following bulletins of apparatus made in its shops: "Isolated Plant Switchboards," "Switchboard Material, etc.," "Motor-Generator Combination from Single-Phase, Alternating to Direct Current," "Alternating-Current Induction Motors," "Diamond 'E' Knife Switches," "Theatre Switchboards," "Alternating-Current, Single-Phase Power Motors," "Standard Knife Switches," "Automatic Illumination Cylinder," "Small Power Alternating-Current Induction Motors" and "Marble Tablet Boards."

The firm of Wilbur B. Driver & Company, 126 Liberty street, New York city, has recently consolidated with F. R. Harris, of Waterbury, Ct., under the name of the Driver-Harris Wire Company. The business of this company will be particularly devoted to the manufacture of resistance wires and fine wires in all metals ranging from No. 15 Brown & Sharpe (.057) to .001. The company announces that it is prepared to furnish brass, copper, phosphor bronze, German silver, iron, steel and any other metal that can be drawn. The business of the two concerns will be carried on as heretofore, but with increased facilities.

HOLIDAY SOUVENIRS.

Alfred F. Moore, Philadelphia, has issued a mammoth wall calendar exploiting his well-known brands of insulated wire.

The Laclede Battery Company, of Kokomo, Ind., has issued a handsome wall calendar illustrated with a pastoral scene in colors.

J. B. Williams & Son, Dover, N. H., manufacturers of leather belting, are mailing to their friends an unusually handsome wall calendar lithographed in colors.

The Phœnix Glass Company, New York city, is remembering its friends with a cute little pocket calendar and stamp case covered with white celluloid made to imitate a stamped envelope.

The ELECTRICAL REVIEW acknowledges the courtesy of the Director-General of the Federal Telegraphs of Mexico in sending compliments of the season, handsomely engraved, to this office.

A beautiful calendar, in colors, showing feminine figures attired in the fashions of the century, has been sent to its friends by the G. F. Brunt Porcelain Works, of East Liverpool, Ohio.

The Phillips Insulated Wire Company, Pawtucket, R. I., has sent to the ELECTRICAL REVIEW a steel-engraved calendar which effectively brings to attention the "O. K." brands of weatherproof line and house wires.

The Audit Company, New York, has issued a beautiful calendar showing views of New York city from the Hudson River in 1880 and 1900. The growth of the "high building district" is well shown in the two pictures.

The *Michigan Central News,* for January, sent to the ELECTRICAL REVIEW by the general eastern passenger agent of the road, Buffalo, N. Y., contains an interesting story called "A Christmas Tree In Japan."

The Western Electric Company, New York, has prepared a wall calendar embellished with a platinum print of its New York city factory as viewed from the Hudson River. The entrance to the offices in the new building is now from 463 West street.

The ELECTRICAL REVIEW is in receipt of a very handsome calendar issued by Hugo Reisinger, 11 Broadway, manufacturer of the well-known "Electra" carbons. The calendar is very attractively finished in red morocco leather, with the name of the company in gilt type. On each daily page there is an announcement concerning the use and advantages of the "Electra" carbons for electric lighting, etc.

ADVANCE INFORMATION

Electric Railways.

MARTIN'S FERRY, OHIO—The county commissioners have granted the franchise for an electric railroad, to connect Bridgeport, Colerain and Mount Pleasant and ultimately Cadiz, to J. A. White and William McComas. The individual right of way is all secured and the surveys made.

NEW ROCHELLE, N. Y.—The Common Council of this city has granted a franchise to the New York, Westchester & Connecticut Traction Company. This action was a surprise, and the company will probably be fought by the citizens before it succeeds in getting possession of the five miles of streets granted it, as they have contended the city's needs for street railways were well supplied. The lines it may build under the franchise will largely compete with the Union Railway lines in the city. The citizens who will fight will probably be aided by the Union Company, which will also make an independent fight.

DOVER, DEL.—The Doty Third-Rail Electrical Company, of New York, has been incorporated here to transact, carry out, manufacture, sell and lease electrical appliances of all kinds. The incorporators are William W. Doty and William Reinhart, of New York city; William F. Wilson and Harry C. Frank, Mount Vernon, N. Y., and James Virden, Dover; capital, $2,500,000.

DUNKIRK, N. Y.—The Dunkirk & Hickoryhurst Electric Railway Company, which has offered the city $6,000 for a franchise, has reorganized and a new board of directors has been chosen. Among the Buffalonians on the board are: Mayor Conrad Diehl, Gen. James E. Curtiss, C. V. Boughton, Dr. Ernest Wende, F. S. Weber, W. A. Calhoun, Louis B. Hart, Dr. B. J. Maycock, William H. Boughton, H. D. Queal.

PROSSER, WASH.—Much is being said at present about building an electric railway from this city to Yakima City. The line could be built and operated at a small expense, as there is at this point an abundant water-power for running dynamos. When completed the line would tap one of the richest and most productive parts of lower Yakima Valley. The line would pass from here through the Euclid settlement, thence through the greater and most important portion of the Sunnyside County, taking in the towns of Sunnyside, Zillah, Parker and Yakima City.

READING, PA.—Judge Eudlich has granted a temporary injunction against the United Traction Company, restraining it from laying a second track in front of H. S. Ninnerslitz's residence, the plaintiff alleging that he had not received damages for the laying of the first.

NORRISTOWN, PA.—A mortgage for $200,000 has been given by the Inland Traction Company, running from Perkasie to Lansdale, to the Lehigh Valley Trust Company, of Allentown. It is for the purpose of securing the payment of bonds issued.

TAUNTON, MASS.—The Bristol County Street Railway Company has been incorporated, the directors being G. H. Swazey, D. A. Brooks, E. D. Hewins (treasurer), E. A. Swazey, E. D. Guild, C. N. Brownell and E. V. Carpenter. The line is to be 12 miles long, and run through Taunton, Rehoboth, Attleboro and Seekonk to the tracks of the Interstate Consolidated Street Railway on the Attleboro road, with a line from the junction of the Oak Hill road and Locust street to the terminus of the Attleboro & Norton Street Railway. The capital is $120,000.

TOLEDO, OHIO—The Toledo, Tiffin & Sandusky Railway Company, of Port Clinton, has been chartered for constructing a street railroad; capital, $3,000,000; incorporators, G. D. Loomis, J. M. Naylor, R. Brown, F. E. Anderson, S. P. Calep, S. B. Hoge, R. Young, W. S. Frye, J. F. Penner, J. McCauley, C. J. Yingling, B. W. Crobaugh, J. C. Roger.

CHARLEROI, PA.—The Charleroi & Monessen Connecting Railroad Company, of Charleroi, has been incorporated to operate a railroad; capital, $50,000; incorporators, W. I. Berryman, C. F. Thompson, J. C. McKean, C. Potter, J. K. Johnston, all of Charleroi, and others.

CANAL FULTON, OHIO—The Canal Fulton Council has granted to the Barberton, Doylestown & Massillon Electric Railway Company a franchise to construct tracks in the village streets.

KANSAS CITY, MO.—A new double track electric line from Rosedale to Olathe and Emporia, Kan., is contemplated. Connecting with the Rosedale Electric Line from Kansas City, the road will extend south to Olathe, thence to Baldwin City and thence to Emporia. It is to be known as the McClure Line. The power house will be located either at Rosedale or at Olathe.

FITCHBURG, MASS.—Carl Dickinson and others have asked for authority to construct and operate a street railway through Ayer, Groton, Townsend, Fitchburg, Lunenburg, Shirley, Harvard, Lancaster, Bolton and Hudson, under the name of the Ayer, Lancaster & Fitchburg Belt Line Street Railway Company. The same petitioner also asks for authority to construct and operate a street railway through Billerica, Carlisle, Chelmsford, Westford, Concord, Lincoln, Acton, Maynard and Hudson, to be known as the Concord & Billerica Street Railway Company.

WORCESTER, MASS.—An ambitious street railway project is outlined in the petition of John A. Dunn, William Tell and others for authority to construct and operate a street railway to be known as the Worcester & Gardner Street Railway, and to run between the two points named.

PITTSFIELD, MASS.—The Pittsfield Street Railway Company petitions for the right to extend its lines into the town of Lenox, and there may be some opposition to this from the Summer residents, who would like to have the quiet of the place retained.

KANSAS CITY, MO.—Arrangements of a preliminary character have been completed for the formation of a company to build and operate an electric railway system in the southeastern and southwestern parts of the city. E. F. Swinney, Richard Gentry, W. D. McLeod, A. A. Tomlinson, Bernard Corrigan, William Huttig, Chas. L. Robson and Joseph J. Helm are interested in the project.

Electric Light and Power.

GOSHEN, IND.—The Indiana Power Company, of Goshen, with a capital stock of $100,000, has been incorporated. The company proposes to erect a dam or dams across the St. Joseph; also to construct a canal for each of the dams, to extend from a point above such dam to some point below the same. Arthur Kennedy, of Pittsburgh, Pa., is principal stockholder, and Charles C. Black, Wilber Syonex, D. H. Hawk, C. L. Starr, George D. Lint, Wilson Roose, Wm. Markel, of Goshen, are the incorporators.

HARTFORD, CT.—There will be an increase in the capital stock of the Farmington River Power Company, which supplies a part of the power used by the Hartford Electric Light Company. This was decided upon at a meeting of the stockholders. The increase will be $15,000, and the present stockholders will be permitted to subscribe for the increase in proportion to their holdings.

GALLITZIN, PA.—The Gallitzin Electric Light and Power Company has increased its plant by the introduction of a new Westinghouse alternator, and is now supplying the light to Cresson and Gallitzin, besides supplying the current to the coal mines.

Telephone and Telegraph.

NEW HAVEN, IND.—The New Haven Home Telephone Company has been incorporated at New Haven to operate telephone lines; capital, $5,000; incorporators, H. F. Berberick, G. W. Miller, both of New Haven; G. F. Trier, of Fort Wayne.

MARSHALL, IND.—The Citizens' Telephone Company, of Marshall, has been formed to operate telephone lines; capital, $10,000; incorporators, J. McMurtry, W. W. Cumminger, S. Hadley, C. Adams, H. Myers, all of Marshall.

CAIRO, IND.—The Cairo Telephone Company has been chartered at Cairo to operate telephone lines; capital, $8,000; incorporators, J. W. Klipinger, V. C. Klipinger, J. E. Roadrock, G. Holwerda, all of Cairo.

WENATCHEE, WASH.—Through the efforts of Arthur Gunn, a telephone exchange is to be built. Enough assistance and orders have been given to make the enterprise an assured success. All of the business houses and many of the residences are to be connected.

DURAND, WIS.—The Pepin Telephone company is to build a line from Pepin to Nelson, connecting Pepin County, Pierce County and Buffalo County lines with Wabasha and Winona, Minn.

ELECTRICAL PATENTS

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED DECEMBER 19, 1899.

639,526 Apparatus for telephonic systems; Frank B. Cook, Chicago, Ill.—In a telephone station, a generator, telephone apparatus and a normally open branch circuit around the receiver, having a suitable resistance therein and means operated by the generator for automatically closing the branch circuit, so that a portion only of the calling current passes through the receiver.

639,528 Telephone transfer board; Frank B. Cook, Chicago, Ill.—In a switchboard, a spring-jack, a plug opening therein, a magnet or magnets in proximity to said opening, and a shutter armature normally away from said opening directly attracted by the magnet to close the jack opening.

639,541 Automobile vehicle; F. L. Dyer and L. H. Dyer, Washington, D. C.

639,557 Electrical snap switch; Monroe Guett, Hartford, Ct.

639,579 Process of recovering zinc from refractory zinc-bearing ores; John Jones, East Melbourne, Victoria.

639,590 Electric transformer; A. H. Loring, Minneapolis, and H. L. Clark, St. Paul, Minn.—A transformer core consisting of two sections, and a connecting device carrying one section and detachably secured to the other section.

639,625 Secondary battery; Oskar Behrend, Frankfort-on-the-Main, Germany.—An electric accumulator, the electrodes of which are separated one from another by a plate or sheet of "huffah."

639,687 Lamp globe; J. G. Pennycuick and F. W. Barrett, Toronto, Canada.

639,688 Circuit-breaker or line opener; F. C. Robertson, Toronto, Canada.

639,690 Electric cane; W. N. Sherman, Merced, Cal.

639,692 Amusement apparatus; Granville T. Woods, New York, N. Y.—An amusement apparatus comprising two or more associate or companion race tracks, each having a motor-driven device combined with an independent speed controller having an accelerating and then retarding action or vice versa, when progressively adjusted along its normal path.

ISSUED DECEMBER 26, 1899.

639,713 Elevated electric car-line; J. H. Cooley, Abilene, Tex.

639,716 Telautograph; F. W. Cushing, Highland Park, Ill.—A signal device, a circuit therefor, two pairs of separable contacts in said circuit, a master-switch and an arm-rest, one of said pairs of contacts controlled by said master-switch and the other pair controlled by said arm-rest.

639,725 Electric heater; E. E. Gold, New York, N. Y.—Comprises an open coil or helix of resilient resistant wire, and an internal support therefor making contact with it at opposed points in its perimeter and arranged to press its convolutions wider apart at said points than its natural shape, whereby it maintains a pressure against said support at said points while its intermediate portions are free to expand and contract.

639,767 Chemical electric excitant; J. Post, New York, N. Y.—An electric excitant, composed of charcoal, glucose, hydrochlorite.

639,768 Telephone attachment; D. Queen, Janlew, W. Va.

639,786 Electric arc-lamp; P. H. F. Spies, New York, N. Y.—Consists of an exhausted enclosing globe, circuit connections and electrodes composed of platinum and gold fused together.

639,792 Repair-tool for use by electric linemen; J. H. Sullivan, Grand Rapids, Mich.

639,811 Electrodepositing anode; H. L. Haas, New York, N. Y.—Consists of a plate or body and an integral upwardly-extending hanger provided with a suspending-hook, having adjacent flat contact faces disposed at an angle with relation to each other and to the plate.

639,824 Electric light appliance for controlling the number of incandescent lights to be burned on a circuit; A. Peters, Manitou, Colo.

639,826 Telephone attachment; H. J. Richardson, Albion, Mich.

639,830 Telephone instrument; J. J. Schoenleber, St. Paul, Minn.

639,849 Portable hand dynamo; S. Evershed, London, England—A rotary brush disk, consisting of two thin metal disks, with a metal flanged spindle upon a central-pin axis and a metal collar pressing said disks together.

639,860 Electric railway; J. M. Murphy, Torrington, Ct.—Consists of a third-rail support and binder, comprising a series of stone blocks, a holding trough and a plastic insulator, filling material held within the trough, and engaging the blocks and the rail and adapted to bind the rail, and the rest blocks.

639,905 Electric battery; John Post, New York, N. Y.

639,948 Junction box or other coupling for casings for electric cable or wires; Aug. Sundh, Yonkers, N. Y.—A flexible metallic casing of spirally-wound strips, or wires for electric cables or conducting wires, said casing having an exterior surface adapted for interlocking with a compressible packing, and a junction box or other connecting socket adapted to be clamped upon the casings, and having means therefor, and a packing of compressible and resilient material between the clamping surfaces of the socket and the casing.

639,957 Regulator for dynamo-electric machines; R. E. Ball, New York, N. Y.—A dynamo-electric machine provided with a brush-carrying yoke, an automatically-movable magnetic body forming part of the magnetic circuit of said machine, and movement multiplying connections between said magnetic body and yoke for actuating the yoke with multiplied movement.

640,001 Electric fuse; Isidor Kitsee, Philadelphia, Pa.—A series of pairs of spring-contacts, normally in electrical connection with each other and provided each with a fuse, and a non-conducting separator designed to separate one or the other of said spring-contacts.

640,006 Storage battery; C. Lindenberger, Hannibal, Mo.

640,056 Electric hair-brush; W. J. Werntz, Annapolis, Md.—An electric brush comprising a back, two shells or jackets arranged longitudinally of the brush, substantially in alinement with each other and fastened respectively to the back and handle of the brush, a dry battery housed within one of said shells, an induction-coil within the other shell, electrodes fastened respectively to the back and the jacket containing the induction coil, a make-and-break device, and circuit connections including the battery, the coil and the make-and-break device.

640,062 Automatic circuit breaker; E. F. Winfield, San Francisco Cal.—A fixed contact and a movable contact, arranged in an electrical circuit so as to automatically make and break, and a dash pot having an expansion space and a plunger connected to the movable contact, the said space being arranged in a defined relation to the point of contact, so as to relieve the resistance at the contact.

640,140 Electrically-illuminated sign; J. E. Lloyd, Cleveland, Ohio.

640,143 Electric heater; R. Lundell, New York, assignor to Bay State Electric Heat and Light Company, Jersey City, N. J.—Consists of a fan, a motor for operating said fan, an electric heater located in front of said fan and consisting of one or more heat-developing electrical conductors or resistances forming an open screen through which air from said fan passes, insulating blocks having grooves in which the conductors or resistances are located and supported, an inner and an outer ring between which said insulating blocks are located, and rods located in grooves in the ends of said insulating blocks and connected to said rings for holding said blocks in position.

640,146 Electric railway; G. W. McClintock, Wollaston, Mass.

PATENTS.

Twenty years continuous practice with the Western Union Telegraph Company, American Bell Telephone Company, General Electric Company, Electrical Accumulator Company, Postal Telegraph-Cable Company, and other electrical companies.

Correspondence and interviews solicited.

W. B. VAN SIZE, 253 Broadway, N. Y.
Solicitor and Expert.

Miniature Lamps
Sockets and Lighting Novelties.
—SEND FOR CATALOGUE.—
General Supplies.
Holiday Goods.
Prices Right.
H. E. PLASS
ELECTRICAL SUPPLY COMPANY,
23 BARCLAY ST., NEW YORK.

SMALL SPRINGS OF EVERY DESCRIPTION
MADE BY
THE WALLACE BARNES CO.
BRISTOL, CONN., U.S.A.
ESTABLISHED 1857.
FLAT OR ROUND WIRE, STEEL OR BRASS.
COLD ROLLED STEEL
KEPT IN STOCK, .003 TO .049 IN THICKNESS.
SPRINGS ENAMELED OR PLATED.
SEND SAMPLES AND WRITE FOR QUOTATIONS.

The New System OF EDUCATION
Steam Engineering

Mechanical, Electrical, Civil and Mining Engineering; Architecture; Drawing; Surveying; Chemistry; Shorthand, Book-keeping and English Branches
TAUGHT BY MAIL.
Students qualified to pass examinations.
We have helped thousands to better positions and salaries. Send for free circulars, stating the subject in which you are interested.
THE INTERNATIONAL CORRESPONDENCE SCHOOLS,
Box 1005, Scranton, Pa.

ELECTRICAL ENGINEERING
TAUGHT BY CORRESPONDENCE.

Study Electricity at home during spare moments and increase your efficiency.
Up-to-date Instruction under technical experts.
Low Tuition Fees, payable in small amounts.
Write for "Handbook B."
American School of Correspondence.
(Chartered by the Commonwealth of Massachusetts.) Boston, Mass., U. S. A.

SUCCESSFUL ELECTRICIANS
are men of education. Success in the electrical profession is impossible without technical knowledge. You can obtain a thorough electrical education at home during your spare time at a cost so low that you will not notice the outlay. Complete courses by mail in **ELECTRICAL ENGINEERING, Electrical Station Engineering, Electric Railways, Electric Lighting, Telephony, Telegraphy, Electro-Plating, Mechanical Drawing and Dynamo-Electric Machine Design. Best Text-Books Free.** The best, most thorough and practical courses of any correspondence school in the world. Seven years of experience in teaching by correspondence. Write for illustrated circular B, sample pages of text-books, drawing plate and booklet of letters from students all over the world.
THE UNITED CORRESPONDENCE SCHOOLS, 154, 156, 158 FIFTH AVENUE, NEW YORK.
with which are incorporated The Correspondence School of Technology and the Institute for Home Study of Engineering.

BULLOCK MOTORS. SEND FOR BULLETIN 0732 & 0735 BULLOCK ELECTRIC MFG. CO., CINCINNATI, O., U. S. A.

CREOSOTED WOOD CONDUITS
WILL LAST FOREVER. EASILY ACCESSIBLE. **FOR UNDERGROUND WIRES.** DO NOT GATHER MOISTURE. DO NOT SCRATCH CABLES.
GET OUR NEW CATALOGUE.
BOSTON AGENTS: F. A. HOUDLETTE & SON, 138 Milk Street.
THE MICHIGAN PIPE CO.,
298 N. Madison St., BAY CITY, MICH.

A National Rider never changes his mount.—National Cycle Mfg. Co., Bay City, Mich.

FOR SALE.

In pursuance of an indenture of assignment, dated the 28th day of December, 1896, the entire plant of the Montego Bay Electric Light Co. (Ltd.). For further particulars and permission to view, apply to any of the under signed:

SAML. HART, Montego Bay; EDGAR TURNBULL, Montego Bay; A. H. BROWNE, Montego Bay; C. REID CAMPBELL, Kingston, Trustees, or C. E. SOAMES, Montego Bay, Jamaica.

FOR SALE.

275 tons of 7-inch Providence girder rail, dimensions and style as cut. This rail has had little or no wear and is in good condition. Can be used for building purposes and can be had for an attractive figure, Chicago delivery. Address

JOHN McNULTA, Receiver,
9314 Drexel Avenue,
CHICAGO, ILL.

Prism.... Globes AND Shades..

GUARANTEED TO GIVE "MAXIMUM LIGHT, COMPLETE DIFFUSION, MINIMUM GLARE," for directing and diffusing ALL KINDS OF LIGHT.....

MANUFACTURED BY THE
HOLOPHANE GLASS CO.,
1 BROADWAY, NEW YORK, N. Y.
Send for Catalogue and Pamphlets.

J. G. White & Company,
INCORPORATED.
ENGINEERS, CONTRACTORS,
29 Broadway, New York, N. Y.
EQUITABLE BLDG., BALTIMORE.

SHEAFF & JAASTAD,
MECHANICAL and ELECTRICAL ENGINEERS.
Plans and specifications for and superintendence of Electric Power and Lighting Plants a specialty.
85 WATER STREET, BOSTON, MASS.

LAMPS
Uniform Candle-Power
UNIFORM IN WATTS PER CANDLE
Prices Right
Prompt Shipment

HARDY LAMP CO.
PITTSFIELD, MASS.

Write for Prices

STEREOPTICONS MAGIC LANTERNS AND SLIDES
CONDENSED CATALOGUE FREE
RILEY BROS 15 BEEKMAN ST. NEW YORK

KLEIN'S

CLIMBER'S LINEMEN'S TOOLS
Catalogue Free. Send for one.
MATHIAS KLEIN & SON,
87-89 W VAN BUREN STREET. CHICAGO, ILL

This Trade-Mark on Sockets, Receptacles, Rosettes, Mains and Branches, Edison Cut-Outs, Knife Switches, Jenkins Snap Switches, etc., **Guarantees Satisfaction**

Philadelphia **H. T. PAISTE CO.** Chicago

H. C. ROBERTS ELECTRIC SUPPLY CO.
831 ARCH ST. PHILADA., PA.
THE BEST GOODS AT FAIR PRICES.

Telephones (Delivered), **$1.25.**
A complete instrument with transmitter, receiver, switch and press-button mounted on base. All parts well finished. Tested for 1,000 feet

The Volt Ammeter, $5.00.
Jewel bearing and aluminum case. Adapted to primary and storage battery. List of schools using it mailed on application.

SEND STAMP for catalogue of telephone and volt ammeter.

L. E. KNOTT APPARATUS CO.,
16 ASHBURTON PLACE, - - - BOSTON, MASS.

POLES · CROSS-ARMS BRACKETS, PINS · TIES
PROMPT SHIPMENT DIRECT FROM MILLS
SAVE BROKERAGES AND SEND US YOUR INQUIRIES
ECCLESTON LUMBER CO.
29 BROADWAY, NEW YORK

FOR AUTOMOBILES

and Gasoline Launches Use the Edison Lalande Batteries.

Light Weight and Liquid Tight. Constant Current and No Waste When Idle. Full Description in Booklet No. 17.

EDISON MANUFACTURING COMPANY,
THOMAS A. EDISON, PROP. 135 FIFTH AVE., NEW YORK.

Electric Fan Manufacturers

who take Father Time's hair by the forelock and early enter the market for next season's sales, are the manufacturers who will get the orders when the day comes 'round. If you'll permit us to advise, advertise during January, February, March, and you'll get TWICE as much business, other things being equal, in April, May, June, as the fellows who do not. The

ELECTRICAL REVIEW

has the consensus of opinion of the manufacturers of Electric Fan Apparatus as being the best journal published for this particular character of advertising. Information as to advertising rates, special positions, etc., etc., sent immediately on application.

Electrical Review... New York.